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Labor supply and expenditures: econometric estimation from Chinese household data

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Labor supply and expenditures:
Econometric estimation from Chinese household data

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DEDICATION

To my family for your unconditional love and support.

TABLE OF CONTENT

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I would like to thank all the people helping me conduct the research and write this dissertation.

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ABSTRACT

This dissertation focuses on labor supply for urban and rural Chinese and the analysis of Chinese rural and urban household expenditures with welfare comparisons.

The first chapter uses data for individuals taken from the 2002 Chinese Household Income Project (CHIP) covering twelve provinces in urban China and twenty-two provinces in rural China to examine decisions of individual's probability of working, wage while working and labor supply. We assume a single wage elasticity for each group of individuals differed by gender and location, and assume fixed housing prices across the locations in urban and rural areas. We find a number of differences between women and men and between rural and urban areas for a given gender.

The second chapter develops the model in the first chapter from several aspects. We permit the estimated wage elasticities of labor supply for low, medium and high wage individuals to differ, and examine the effects of housing prices on labor supply. The results suggest that labor supply elasticities differ by the location of an individual in the wage distribution and high housing prices increase labor supply for urban men and women and rural men.

The third chapter examines Chinese rural and urban household expenditures on goods and services using an Almost Ideal Demand System (AIDS) fitted to provincial aggregate data over 2002-2011 and uses the estimated coefficients to provide estimates of income and price elasticities of demand for six commodity groups. We use these estimates to make welfare comparisons over time for rural and urban households. Our preferred rural-urban household welfare comparison shows that the welfare growing at approximately 1% per year

for urban Chinese households and 1.5% for rural Chinese households and with a small amount of convergence (4%) over the study period.

CHAPTER 1

LABOR FORCE PARTICIPATION, WAGE WHILE WORKING AND LABOR SUPPLY FOR CHINESE WOMEN AND MEN IN RURAL AND URBAN AREAS, 2002

Abstract

This paper uses data for individuals taken from the 2002 Chinese Household Income Project (CHIP) covering twelve provinces in urban China and twenty-two provinces in rural China to examine decisions of individual's probability of working, wage while working and labor supply. We assume a single wage elasticity for each group of individuals differed by gender and location, and assume fixed housing prices across the locations in urban and rural areas. We find a number of differences between women and men and between rural and urban areas for a given gender.

1 Introduction

Two most important determinants of wage rates—education and gender, has been discussed in a lot of literatures using Chinese household and individual datasets. The economic return to education is higher for women than that for men (Knight and Song 2003). Although abundant research on labor participation rate and labor supply have been conducted for countries such as U.S., Japan, Korea and Taiwan, the study on labor supply of China is very limited. One of the most recent paper on labor supply for China is Li and Zax (2003). They found a positive wage effect and a negative income effect on labor supply of Chinese adults using cross-sectional data for 1995.

Moreover, the wage rates for urban women and men are much higher than for rural women and men. The huge Rural-urban wage rate differentials for men and women and regional differences in China might exert an effect on individuals' labor supply decisions. However, the research on labor market differentials between urban and rural China has been rarely conducted. We anticipate a difference on the labor supply between urban and rural Chinese.

Our paper reports an econometric analysis of labor force participation, wage rate while working and labor supply for Chinese men and women in rural and urban areas in 2002. In addition to human capital variables, we permit the ownership type of an individual's employer to affect their wage rate. Two categories are designated—public and private sectors. We use data for individuals taken from the 2002 Chinese Household Income Project (CHIP) covering twelve provinces in urban China and twenty-two provinces in rural China to estimate the equations for labor force

participation, wage rate and labor supply.

We assume a single wage elasticity for each group of individuals differed by gender and location and fixed housing prices across the locations in urban and rural areas in our model. The labor market is independent of the housing market heterogeneities. We examine the effects of wage rates on hours of work (labor supply) for urban and rural Chinese and our results suggest that the wage elasticities of labor supply are all negative for urban men and women and rural men and women. In Chapter 2, we provide a developed model to permit different wage elasticities for high, medium and low wage rate groups and examine how the housing market heterogeneities distort labor market in China. Detailed literature review is included in Chapter 2.

This paper is structured as follows: Section 2 provides a simplified model for estimating wages and hours of work to explore the individuals' work behavior; Section 3 provides a brief description of the data; Section 4 presents the empirical results; and Section 5 provides conclusions.

2. Conceptual Model

This section lays out the conceptual model—labor demand, labor supply and labor force participation. Individuals in our dataset that have an urban residence reside in one of 77 cities, and those with a rural residence reside in one of 122 counties.

Labor participation rate.

In 2002, 79.3% of men living in urban China and 83.9% of men in rural China participated in the labor force (see Table 1 and 2). The labor force participation rate

for women in urban areas is 67.5% and in rural areas is 74.4%. The fact that not everyone works for a wage is the potential source for the sample selection bias in the wage and labor supply equations.

The economics of the decision to participate in the labor forces is as follows. The *i*-th individual chooses to work for a wage if his/her market wage offered (from the labor demand equation) exceeds his/her reservation wage (which is derived from the labor supply equation). We define D_i as the indicator for labor force participation of the *i*-th individual, taking a value of 1 if the *i*-th individuals reservation wage, $\ln w_i^R < \ln w_i$ and $D_i = 0$ otherwise. Then the probability of the *i*-th individual working is:

$$p_i = \Pr(D_i = 1) = \Pr(\varepsilon_i < X_{1i}\phi_1) = F(X_{1i}\phi)$$

where F( ) is the distribution function associated with a symmetric density function $f_\varepsilon(\,)$. If $f_\varepsilon(\,)$ is a uniform density function over ε, then F( ) is a triangular distribution and the basis for the linear probability model of labor force participation:

$$(1)\ D_i = \delta_0 + \delta_1 Age_i + \delta_2 Age_i^2 + \delta_3 Edu_i + \delta_4 \ln NonlaborIncome_i + \delta_5 Familysize_i + \delta_6 Married_i + \sum_k \delta_{7k} D_{location,ik} + u_{1i}$$

where Age_i is the *i*-th individual's age in years, Edu_i is the *i*-th individual's number of years of schooling completed. $\ln NonlaborIncome_i$ is the natural logarithm of the *i*-th individual's annual real nonlabor income, e.g., gifts, subsidies, etc. $Familysize_i$ refers to the total number of individuals in the *i*-th individual's household. $Married_i$ is a dummy variable taking a value of 1 if the *i*-th individual is married and 0 otherwise. Provincial dummies are also included in the labor participation equation. The random

disturbance term u_{1i} represents the effects of other variables on the *i*-th individual's labor participation decisions.

Labor demand.

The general form of the empirical labor demand equations is:

$$\ln w_i = X_{2i}\alpha_i + u_{2i}$$

where $\ln w_i$ is the natural logarithm of the *i*-th individual's real hourly wage; X_{2i} represents an individual's education, age and age squared, provincial-level fixed effects, labor market dummies across the population of all individuals in an area, and the ownership type of work units. The random disturbance term u_{2i} represents the effects of other variables on the *i*-th individual's wage. Across the population of individuals in a given region, we anticipate that Eu_{2i} =0. A public-private designation for employer ownership type exists. To obtain comparable results for urban men and women, ownership types of self-employed and private enterprise are combined to make a new private sector ownership type for men and women. Public ownership then includes employments by public enterprise, institution and government agency.

The specific form of the wage equation is as follows:

$$(2)\ \ln w_i = \alpha_0 + \alpha_1 Age_i + \alpha_2 Age_i^2 + \alpha_3 Edu_i + \alpha_4 D_{ownership,i} + \sum_k \alpha_{5k} D_{location,ik} + u_{2i}$$

where dummy variables $D_{ownership,i}$ control for the ownership type of the work unit: public sector or private sector. Consistent with the literature, we estimate separate wage equations for women and men.

Individual Labor Supply.

Key variables expected to explain an individual's labor supply are his/her wage,

individual nonlabor income and other socio-demographic variables (X_{3i}):

$$\ln H_i = \theta \ln w_i + X_{3i}\beta_3 + u_{3i}$$

where $\ln H_i$ is the natural logarithm of the i-th individual's annual hours of work; and u_{3i} represents the effects of other variables on the i-th individual's labor supply. The expect sign of θ could be positive, negative or even zero. To add further empirical contents to the labor supply equation, we further define the variables that are included in X_{3i}: nonlabor income, family size and marital status.

$$(3)\quad \ln H_i = \beta_0 + \beta_1 \ln w_i + \beta_2 \ln NonlaborIncome_i + \beta_3\ Familysize_i + \beta_4\ Married_i + u_{3i}$$

3 Data Description

Our data are from the Chinese Household Income Project (CHIP) conducted in twelve provinces in urban China and twenty-two provinces in rural China in 2002. CHIP-2002 collects demographic and economic data which is useful in explaining market behavior of adults and households.

Under the Chinese Law on Employment Contracts, individuals who are 16 years of age and older are permitted to work. To be consistent with the law, we restrict our sample to those individuals who were 16-64 years old. Our sample consists of 0.003% of the national population, which is a good representative of the adult population of urban and rural China in 2002.

Figures 1 shows that the average log hourly wage rate for men is much higher than for women in both rural and urban areas. For urban individuals, men receive 12% more than women. The log wage rate for rural men is 39% higher than for women.

There exists a huge wage differential between urban and rural areas. Urban men earn a 92.2% higher wage rate than rural men. The log wage rate for urban female workers is 133.3% higher than for rural women.

Table 1 and Table 2 provide short definitions of variables and summary statistics. Our urban sample consists of 12,024 individuals, 6,269 (52%) are men and 5,755 (48%) are women. The average age of men is 38.6 years old, and slightly larger than the average age of women, which is 36.5 years old. The average amount of education is 11.4 years for men and 10.9 years for women. Annual hours of working for urban men are 2,274.4 hours, which is slightly larger than 2,208.3 annual hours of working for urban women.

Our rural sample consists of 27,126 individuals, 14,213(52%) are men and 12,913(48%) are women. The average age of men in rural China is 36.8 years old and 36.1 years old for women. Men and women have completed an average of 7.9 and 6.7 years of schooling, respectively. The education level for rural Chinese is much lower than urban Chinese. The average log real hourly wage in rural China is about one half of the log wage rate in urban China. The average hours of work for rural women and men are approximately 30% less than for workers in urban areas.

4 Empirical Results

Empirical results from fitting the labor force participation, wage and labor supply equations to the CHIP data for 2002 are presented and discussed. Separate equations are fitted for men and women and for rural and urban residents.

Table 3 presents the estimated coefficients for fitting OLS model for labor force

participation. The marginal effect of an individual becoming older is to increase the probability of working when she/he is young, but as she/he becomes older, the size of the marginal effect declines and becomes zero at 44.2 and 41.3 years of age for urban men and women, respectively, and 42.8 and 39.0 years for rural men and women, respectively. When an individual is older than the appropriate value, the probability of him/her working declines as he or she ages. For urban men and women, the marginal effect of an additional year of education is to significantly increase his/her probability of working. However, in rural areas, the marginal effect of an additional year of male and female education is to reduce his/her probability of working in the market.

An increase in the family size significantly decreases the probability of working in the market for urban women. Rural men and women are more likely to work if the family size is large. One explanation is that women take primary responsibility for housework, such as raising children and doing the laundry; while working in the market is a stronger norm for men than women.

Being married significantly increases the probability of working in the market for rural men and urban men at 1% significance level. The primary reason is that the financial cost of raising children, which makes the married males more likely to work. Urban women also are more likely to work.

Table 4 presents the estimated labor demand equations without selection for urban men and women and rural men and women where the employer ownership type is permitted to be a factor explaining wage differences. The results suggest as an individual's age or experience rises, the wage rates for urban men and women

increase but the magnitudes of the increases decline as the individual grows older. These results in Table 4 imply a positive return to experience in the form of higher wage rates for men and women in urban and rural China. The economic return to experience peaks at 56.1 years of age for urban men and 76.7 years of age for urban women. The wage rate peaks at 45.3 years of age for rural men and 50.0 years of age for women. The estimated return to a year of schooling is significantly higher for women than men and for urban than rural adults.

The schooling effects are statistically strong. For urban men, an additional year of education increases their wage by 5.3%. For urban women, the marginal effect of education is larger, 6.6% which is consistent with previous literatures that the economic return to women is larger than for men. For rural men the estimated return is 2.0% and for women is 2.4%. Hence, the return to a year of education in rural China is quite low, and we expect educated individuals initially living in rural areas to migrate for work to urban areas. In the urban labor market, an individual being employed in the public sector increases men's wage rate by 11.7% and women's wage rate by 18.6%. In the rural labor market, the wage rate is 16.1% higher for men and 17.2% for women when they are employed by the public sector.

Table 5 represents the point estimate of the labor supply differed by gender and region. The income effect on labor supply is negative and significant at 1% level for urban men and women and rural men and women. For rural men and women, additional non-labor income increases their hours of work. The positive income effect on labor supply is significantly different from zero at the 1% level for rural women

and men. The negative estimated coefficient for urban men and positive estimated coefficient for rural men and women imply that leisure is a normal good for urban men but an inferior good for rural men and women.

One percent wage rate increase reduces the labor supply by 0.17% for urban men, 0.20% for urban women, 0.27% for rural men and 0.34% for rural women. Women and men in urban areas who are married work more than those who are not married. However, for rural men and women, being married reduces their labor supply. The family size has a significant negative effect on labor supply of rural men: a larger family size tends to reduce labor supply for rural men.

For urban men and women, the wage elasticities of labor supply are negative, -0.17 and -0.20, respectively. For rural women and men, the wage elasticities of labor supply are negative, -0.27 for men and -0.34 for women. The wage elasticity for women is higher than for men.

5 Conclusions

In this paper, we observe a number of differences between women and men and between rural and urban areas for a given gender. First, the return to education through the wage rate for market work is statistically positive and large for urban women and men but smaller for rural women and men. Second, the wage equations contain a concave age-experience effect confirming positive returns to experience up to late middle-age. Third, wage rates are significantly higher (12%-19%) for those adults working in the public sector. Fourth, the wage elasticity of labor supply differs between men and women, and rural and urban areas. The wage elasticity of labor

supply is larger for women than men.

However, the estimated coefficients could be biased from several aspects. First, the sample selection bias exists as not all the individuals work for wages. The *i*-th individual chooses to work for a wage if his/her market wage offered (from the labor demand equation) exceeds his/her reservation wage (which is derived from the labor supply equation). This clearly makes labor force participation a rational economic decision and a non-random process, and this implies that the sample of workers is a select sample from the larger population. Ignoring this selection process can bias the estimated coefficients of wage and labor supply equations.

Second, the wage elasticities of labor supply are -0.169, -0.199, -0.273, -0.338 for urban men and women and rural men and women, respectively. The negative wage elasticities indicate that leisure is a normal good. However, individuals with low, medium and high wage rates might differ in response to a higher wage. Costa (2002) found for the U.S. in 1890s that low wage individuals worked the longest hours and high wage individuals worked the fewest hours while in 1991 high wage individuals worked more. We expect wage elasticity differentials exist among individuals at different wage rate levels.

Third, we assume that the housing prices are fixed across all locations. Since the housing price affects the real wage rate, we expect that the housing market heterogeneities might exert an effect on the labor market. The housing price variable will be included in our developed model.

We will revisit these problems in Chapter 2.

References

Fleisher B., Wang X., 2004. *Skill differentials, return to schooling, and market segmentation in a transition economy: the case of Mainland China*, Journal of Development Economics, Volume 73, Issue 1, Pages 315-328

Gustafsson B., Li S., 2000. *Economic transformation and the gender earnings gap in urban China*, Journal of Population Economics, 13: 305-329

Heckman J.J., 1979. *Sample selection bias as a specification error*. Econometrica, 153-161.

Heckman J.J., 1993. *What has been learned about labor supply in the past twenty years?* The American Economic Review, Vol. 83, No.2 pp.116-121

Hill M. A., 1989. *Female Labor Supply in Japan: Implications of the Informal Sector for Labor Force*, Journal of Human Resources, Vol.24, pp. 143-161

Huffman W.E. and Feridhanusetyawan T., 2007. *Migration, Fixed Costs, and Location-Specific Amenities: A Hazard Analysis for a Panel of Males*, American Journal of Agricultural Economics, 89(2):368-382

Ilmakunnas S. and Pudney S., 1990. *A model of female labour supply in the presence of hours restrictions*, Journal of Public Economics 41,183-210

Knight J., Song L., 2003. *Increasing urban wage inequality in China*, Economics of Transition, Volume 11, Issue 4, pages 597–619

Lee B.S., Jang S., Sarkar J., 2008. *Women's labor force participation and marriage: The case of Korea*, Journal of Asian Economics, Volume 19, Issue 2, Pages 138–154

Li H. and Zax J. S., 2003. *Labor supply in urban China*, Journal of Comparative Economics 31, 795-817

Liu P., Meng X., Zhang J., 2000. *Sectorial gender wage differentials and discrimination in the transitional Chinese economy*, Journal of Population Economics, 13: 331-352

Pencavel J., 1998. *The Market Behavior and Wages of Women: 1975-94*, The Journal of Human Resources. Vol. 33. No. 4

Pencavel J., 2002. *The Cohort Analysis of the Association between Work hours and Wages among Men*, The Journal of Human Resources. Vol. 37. No. 2

Sasaki M., 2002. *The Causal Effect of Family Structure on Labor Force Participation among Japanese Married Women*, The Journal of Human Resources, Vol. 37, No. 2, pp. 429-440

Shi, Li. *Chinese Household Income Project*, 2002. ICPSR21741-v1. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2009-08-14. http://doi.org/10.3886/ICPSR21741.v1

Zhang L., Brauw A. D., Rozell S. 2004. *China's rural labor market development and its gender implications*, China Economic Review, Volume 15, Issue 2, Pages 230–247

Zhang J., Zhao , Y. , Park A., Song X., 2005. *Economic returns to schooling in urban China, 1988-2001*, Jorunal of Comparative Economics, 730-752

Figure 1. Average log Hourly Real Wage Rate in Urban and Rural China (Yuan), 2002

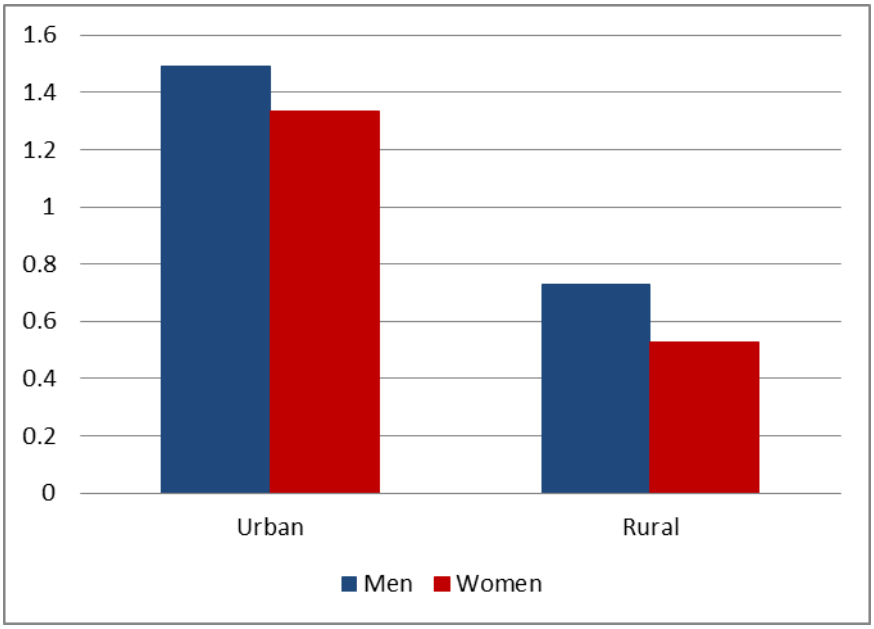

Table 1. Variable Definitions and Descriptive Statistics for Urban Chinese, 2002

Variables	Definitions	Men(N=6,269) Mean(SD)	Women(N=5,755) Mean(SD)
Age	Years of age	38.636(11.808)	36.545(11.076)
Age-squared/100	Age squared/100	16.321(8.788)	14.582(8.064)
Education	Years of education	11.400(3.062)	10.899(3.204)
Married	1 if the individual is married; 0 otherwise	0.760(0.427)	0.757(0.429)
Family Size	Numbers of family members in the household	3.211 (0.751)	3.244 (0.799)
Work status	1 if the individual works; 0 otherwise	0.793(0.405)	0.675(0.468)
ln Wage	Logarithm of real hourly wage rate	1.493(0.607)	1.334(0.631)
Hour of work	Annual hours of work	2,274.4(617.0)	2,208.3(621.8)
Wage income	Annual wage income	10,491.7(8,412.5)	7,921.8(6,544.7)
ln NonlaborIncome	Logarithm of Annual nonlabor income	9.273(1.418)	9.508(1.094)
Ownership type of employer:			
Private Sector	1 if the individual works in Private sector; 0 otherwise	0.061(0.239)	0.050(0.219)
Public Sector	1 if the individual works in Public sector; 0 otherwise	0.647(0.478)	0.545(0.498)
ln housing price	ln average area real housing price	3.223(0.471)	3.169(0.524)
Sex ratio	The sex ratio of men to women	104.596(3.099)	104.602(2.970)

Table 2. Variable Definitions and Descriptive Statistics for Rural Chinese, 2002

Variables	Definitions	Men(N=14,213) Mean(SD)	Women(N= 12,913) Mean(SD)
Age	Years of age	36.762(13.582)	36.081 (13.018)
Age-squared/100	Age squared/100	15.359(10.342)	14.713 (9.712)
Education	Years of education	7.875(2.500)	6.682(2.985)
Married	1 if the individual is married; 0 otherwise	0.698(0.459)	0.745(0.436)
Family Size	Numbers of family members in the household	4.429(1.368)	4.509(1.362)
Work status	1 if the individual works;0 otherwise	0.839(0.367)	0.744(0.436)
ln Wage	Logarithm of real hourly wage rate	0.728(0.856)	0.525(0.798)
Hours of work	Annual hours of work	1,502.6(946.1)	1,735.7(990.5)
Wage income	Annual wage income	3,783.3(4,574.8)	3,568.2(3,531.8)
ln NonlaborIncome	Logarithm of annual nonlabor income	4.019(4.042)	5.878(3.619)
Private Sector	1 if the individual works in Private sector; 0 otherwise	0.265(0.441)	0.148(0.355)
Public Sector	1 if the individual works in Public sector; 0 otherwise	0.064 (0.244)	0.031(0.172)
ln housing price	ln average area real housing price	2.281(0.494)	2.284(0.497)
Sex ratio	The sex ratio of men to women	104.485(2.502)	104.422(2.514)

Table 3. The estimated coefficients fitting Labor Force Participation for Men and Women, Urban and Rural Chinese, 2002

	Urban		Rural	
Regressors	Men	Women	Men	Women
Age	0.091***	0.105***	0.065***	0.064***
	(0.003)	(0.004)	(0.002)	(0.002)
Age-squared/100	-0.103***	-0.127***	-0.076***	-0.082***
	(0.003)	(0.005)	(0.002)	(0.003)
Education	0.015***	0.037***	-0.010***	-0.003*
	(0.001)	(0.002)	(0.001)	(0.001)
ln Nonlabor Income	0.003	-0.012**	-0.004***	-0.007***
	(0.003)	(0.005)	(0.001)	(0.001)
Married	0.131***	0.036*	0.033***	0.013
	(0.017)	(0.020)	(0.010)	(0.014)
Family size	-0.000	-0.023***	0.007***	0.007**
	(0.005)	(0.007)	(0.002)	(0.003)
Constant	-1.321***	-1.494***	-0.396***	-0.542***
	(0.060)	(0.088)	(0.038)	(0.051)
R^2	0.481	0.352	0.272	0.174

Note:*significant at 0.1; ** significant at 0.05; *** significant at 0.01

Table 4. OLS Estimation of log wage without selection, urban and rural China

	Urban		Rural	
Regressors:	Men	Women	Men	Women
Age	0.046***	0.023***	0.068***	0.033***
	(0.007)	(0.009)	(0.005)	(0.009)
Age-squared/100	-0.041***	-0.015	-0.075***	-0.033***
	(0.008)	(0.011)	(0.007)	(0.013)
Education	0.053***	0.066***	0.020***	0.024***
	(0.003)	(0.003)	(0.004)	(0.006)
Public	0.117***	0.186***	0.161***	0.172***
	(0.022)	(0.026)	(0.029)	(0.042)
Constant	0.031	0.183	-0.523***	-0.132
	(0.143)	(0.171)	(0.125)	(0.172)
R^2	0.195	0.225	0.155	0.215

Note:*significant at 0.1; ** significant at 0.05; *** significant at 0.01

Table 5. OLS Estimates of ln Hours Worked (Labor Supply) without Selection for Chinese Men and Women in Urban and Rural China, 2002

	Urban		Rural	
Regressors	Men	Women	Men	Women
ln wage	-0.169***	-0.199***	-0.273***	-0.338***
	(0.007)	(0.008)	(0.019)	(0.026)
ln NonlaborIncome	-0.006**	0.002	0.238***	0.358***
	(0.003)	(0.004)	(0.014)	(0.018)
Married	0.088***	0.025*	-0.121***	-0.458***
	(0.014)	(0.015)	(0.034)	(0.040)
FamilySize	0.009	-0.008	-0.052***	0.004
	(0.005)	(0.007)	(0.011)	(0.015)
Constant	7.884***	7.893***	5.804***	4.650***
	(0.034)	(0.043)	(0.115)	(0.160)
R^2	0.131	0.157	0.123	0.220

Note: *significant at 0.1; ** significant at 0.05; *** significant at 0.01

Table 6. Wage Elasticities for Chinese Men and Women, Urban and Rural China, 2002

	Urban		Rural	
	Men	Women	Men	Women
Wage Elasticity	-0.169	-0.199	-0.273	-0.338

CHAPTER 2

LABOR FORCE PARTICIPATION, WAGES, HOUSING PRICES AND LABOR SUPPLY: CHINESE WOMEN AND MEN IN RURAL AND URBAN AREAS, 2002

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Abstract

We use data for individuals taken from the 2002 Chinese Household Income Project (CHIP) covering twelve provinces in urban China and twenty-two provinces in rural China to examine the decisions of individual's probability of working, wage while working and labor supply as well as the effect of housing price on the labor market. We permit the estimated wage elasticities of labor supply for low, medium and high wage individuals to differ. The results suggest that labor supply elasticities differ by the location of an individual in the wage distribution and high housing prices increase the labor supply for urban men and women and rural men.

1 Introduction

Several papers have reported on the effects of a worker's education and gender on their wage rates. Although China is a large country by area and total population where large economic differences exist across these provinces and significant socio-economic discrepancies exist between rural and urban China, the research has been barely conducted on the rural-urban and regional differences on individuals' labor supply decisions.

The objective of this paper reports on an econometric analysis of labor force participation, wage rate while working and labor supply for Chinese men and women in rural and urban areas. We observe negative wage elasticities for urban men and women and rural men and women in the first chapter. However, the estimated coefficients could be biased from several aspects. First, the sample selection bias exists as not all the individuals work for a wage. This clearly makes labor force participation a rational economic decision and a non-random process, and this implies that the sample of workers is a select sample from the larger population. Ignoring this selection process can bias the estimated coefficients of wage and labor supply equations.

Second, with the large variance in wage rates across individuals in China, the wage elasticity of labor supply may not be a single constant but instead differs with the wage rate received. The negative wage elasticities in Chapter 1 indicate that leisure is a normal good. However, individuals with low, medium and high wage rates

might respond differently to a high wage rate. Costa (2000) discusses U.S. wage rates and hours of work over time and across occupations and industries over approximately a century. She found that in the 1890s high-paid individuals worked the fewest hours and low-paid individuals worked the longest hours; but in 1991, the hours of work were largest for high-paid workers. Her results suggest that this change evolved slowly over time. Since the wage rates differ by a large amount in 2002 in China, we permit the estimated wage elasticities of labor supply for low, medium and high wage individuals to differ and test for significant differences. We anticipate that at least in urban areas we will see significant differences.

Third, according to the data from the Chinese Urban Household Survey and Chinese Rural Household Survey in 2002-2011 conducted by National Bureau of Statistics of China, housing costs account for approximately 11% and 18% of total household expenditure for urban and rural Chinese, respectively. Since housing costs consume a significant share of most household's income; and housing and leisure are jointly demanded in the classical household decision-making model, we incorporate the price of housing into our labor supply model and examine how the housing costs affect the labor supply for urban and rural Chinese. The relationship between labor market and housing price has barely been explored empirically across cities in urban and counties in rural China. The housing price affects the real wage rate thus we expect that the housing market heterogeneities might exert an effect on the labor market. We use the housing price based on the distance to the centers in 77 cities

within twelve provinces in urban areas and 122 counties in twenty-two province in rural areas in China and sketch an econometric model with the housing price variable incorporated to examine the labor demand, labor supply and the effects of housing prices on labor supply for Chinese men and women.

We use data for individuals taken from the 2002 Chinese Household Income Project (CHIP) covering twelve provinces in urban China and twenty-two provinces in rural China to estimate the equations for labor force participation, wage rate and labor supply. Our estimated coefficients show that the wage elasticities of labor supply are positive for low-wage urban men and women and rural men and women; for the high-wage urban men and women, their hours of work decline with their wage rates but high-wage rural men and women work more when the wage rates are high. The wage differentials exist between urban and rural areas, and the effect of wage rate on labor supply varies by urban and rural areas and by gender.

This paper is structured as follows: Section 2 documents the literature review on wages in China and hours of work. Section 3 provides the model for estimating wages and hours of work to explore the individuals' work behavior; Section 4 provides a brief description of the data; Section 5 presents the empirical results; and Section 6 provides conclusions.

2. Literature Review

Two most important determinants of wage rates in China—education and gender, has been discussed in a lot of literatures using Chinese household and individual

datasets. Knight and Song (2003) used household data in 1988 and 1995 to investigate wage inequality. They found growing gender wage inequality between men and women. Using data for 2001, Zhang et al. (2005) showed that one additional year of education increased wage rates by 8.4% and 13.2% for men and women, respectively. Gustafsson and Li (2000) found an increasing wage premium for more educated Chinese workers and the wage gap existed among women and men.

Abundant research on labor participation rate and labor supply have been conducted for countries such as U.S., Japan, Korea and Taiwan. Pencavel (1998) reported a positive labor supply elasticity using data for the U.S. from 1975-1994. Hill (1989) studied labor force participation and hours of work for female workers in Japan. Using Korean data for 2000, Lee et al. (2008) examined that the effect of the marital status on the labor force participation rate of women. They found that compared to the unmarried women, married women were 40%-60% less likely to work.

However, limited research have been conducted empirically for Chinese labor market, especially for urban and rural labor market differentials. According to statistics from World Bank, the labor force participation rate for women and men decreases steadily over 1990-2011. One of the most recent paper on labor supply for China is Li and Zax (2003). They found a positive wage effect and a negative income effect on labor supply of Chinese adults using cross-sectional data for 1995.

One paper focused on both housing price and labor supply is Davidoff (2006).

He suggests that the relation between housing as one of most important assets and labor income as one majority resource of income explain the polarization of households: households own less housing when their income-housing price variance is large. Desirable amenities, such as high quality schools and hospitals, explain part of the housing price discrepancies between urban and rural areas. Previous studies assume that the housing prices are fixed across the locations. However, the heterogeneity of housing price in the housing market might affect the labor market as the housing price affects the real wage rate. Another objective of this paper is to examine the effects of housing prices on the labor supply for Chinese men and women in rural and urban areas. Deutsch et al. (2001) found that the types of housing affected the hours of work for women and men. We expect that the housing prices exert some effects on labor supply for China.

3. Conceptual Model

This section lays out the conceptual model—labor demand, labor supply and labor force participation. We use the data from Chinese Household Income Project in 2002 and examine how the heterogeneity in the housing market affects the labor market. Individuals in our data set that have an urban residence reside in one of 77 cities, and those with a rural residence reside in one of 122 counties. The prices of housing for individuals residing in cities are derived from the average expenditures on housing per square-meter based on the distances to the center of the city. In rural areas, we lack meaningful specific location data for the housing within one county, thus one

average market price for housing is generated for all individuals living in that county.

Labor demand.

The general form of the empirical labor demand equations is:

$$\ln w_i = X_{1i}\alpha_i + u_{1i}$$

where $\ln w_i$ is the natural logarithm of the i-th individual's real hourly wage; X_{1i} represents an individual's education, age and age squared, provincial-level fixed effects, labor market dummies across the population of all individuals in an area, and the ownership type of the work units. The random disturbance term u_{1i} represents the effects of other variables on the i-th individual's wage. Across the population of individuals in a given region, we anticipate that $Eu_{1i}=0$. A public-private designation for employer ownership type exists. To obtain comparable results for urban men and women, ownership types of self-employed and private enterprise are combined to make a new private sector ownership type for men and women. Public ownership then includes employments by public enterprise, public institution and government agency.

The specific form of the wage equation is as follows:

$$(1)\ \ln w_i = \alpha_0 + \alpha_1 Age_i + \alpha_2 Age_i^2 + \alpha_3 Edu_i + \alpha_4 D_{ownership,i} + \sum_k \alpha_{5k} D_{location,ik} + u_{1i}$$

where dummy variables $D_{ownership,i}$ control for the ownership type of the work unit where the i-th individual is employed (public sector or private sector). Consistent with the literature, we estimate separate wage equations for women and men.

Individual Labor Supply.

Key variables expected to explain an individual's labor supply are his/her wage,

local housing price, individual's nonlabor income and other socio-demographic variables (X_{2i}):

$$\ln H_i = \theta \ln w_i + \psi \ln P_h + X_{2i}\beta_2 + u_{2i}$$

where $\ln H_i$ is the natural logarithm of the i-th individual's annual hours of work; P_h denotes the real housing price per square meter faced by the individual; and u_{2i} represents the effects of other variables on the i-th individual's labor supply. The expect sign of θ could be positive, negative or even zero.

With the large variance in wage rates across individuals in China, the wage elasticity of labor supply may not be a single constant but instead differs with the wage rate received. To test this hypothesis, we create three wage groups: the bottom quarter represents the low-paid individuals, the top quarter represents the top-paid individuals; and those in between are medium-paid individuals. To implement this structural difference, define D_{Li} to be a dummy variable taking a value of 1 if the i-th individual is in the bottom quarter of the wage distribution and 0 otherwise; D_{Hi} to be a dummy variable taking a value of 1 if the i-th individual is in the top quarter of the wage distribution and a 0 otherwise. Two new wage variables interacted with D_{Li} and D_{Hi} are then added to the empirical labor supply equations:

$$(2)\ \ln H_i = \beta_0 + \beta_1 \ln w_i + \gamma_1 D_{Li} \ln w_i + \gamma_3 D_{Hi} \ln w_i + \beta_2 \ln P_h + \beta_3 \ln NonlaborIncome_i + \beta_4 Familysize_i + \beta_5 Married_i + u_{2i}$$

To add further empirical contents to the labor supply equation, we further define the variables that are included in X_{2i} : $NonlaborIncome_i$ is the i-th individual's annual real

nonlabor income, e.g., gifts, subsidies, etc. $Familysize_i$ refers to the total number of individuals in the i-th individual's household. $Married_i$ is a dummy variable taking a value of 1 if the i-th individual is married and 0 otherwise.

Next, consider the empirical labor force participation equation. Define D_i as the indicator for labor force participation of the i-th individual, taking a value of 1 if the i-th individuals reservation wage, $\ln w_i^R < \ln w_i$ and $D_i = 0$ otherwise. Then the probability of the i-th individual working is: $p_i = \Pr(D_i = 1) = \Pr(\varepsilon_i < X_{3i}\phi_3) = F(X_{3i}\phi)$, where F( ) is the distribution function associated with a symmetric density function $f_\varepsilon(\,)$ and X_{3i} is a vector of variables: [Age_i, Age_i^2, Edu_i, ln$NonlaborIncome_i$, $Familysize_i$, $Married_i$,location dummies].

The economics of the decision to participate in the labor forces is as follows. The i-th individual chooses to work for a wage if his/her market wage offered (from the labor demand equation) exceeds his/her reservation wage (which is derived from the labor supply equation). This clearly makes labor force participation a rational economic decision and a non-random process, and this implies that the sample of workers is a select sample from the larger population. Ignoring this selection process can bias the estimated coefficients of wage and labor supply equation.

In 2002, 79.3% of men living in urban China and 83.9% of men living in rural China participated in the labor force (see Table 1 and 2). The labor force participation rate for women in urban areas is 67.5% and in rural areas is 74.4%. The fact that not everyone works for a wage is the potential source for sample selection bias in the

wage and labor supply equations. To correct the selection bias for estimated coefficients of wage and labor supply equations, Heckman (1979) suggests that treating the *i*-th individual's probability of working or the inverse Mills ratio as an omitted variable is a fruitful route to pursue. This means adding an estimate of this factor as a regressor to the *i*-th individual's labor demand and supply equations. We follow Heckman (1979) applying Probit or OLS model and add an estimate of the individual's probability of working as a regressor to the *i*-th individual's labor demand and supply equations to control the sample selection.

Angrist (2002) discussed the effect of sex ratios on the labor market in United States. We test the hypothesis that the sex ratios affect the individuals' labor participation decisions. We use the provincial sex ratio data for China in 2002 and examine the effect of sex ratios instead of provincial dummies to control the location-specific fixed effects on the labor participation decisions.

4 Data Description

Our data are from the Chinese Household Income Project (CHIP) conducted in twelve provinces in urban China and twenty-two provinces in rural China in 2002. CHIP-2002 collects demographic and economic data which is useful in explaining market behavior of adults and households.

Under the Chinese Law on Employment Contracts, individuals who are 16 years of age and older are permitted to work. To be consistent with the law, we restrict our sample to those individuals who were 16-64 years old. Our sample consists of 0.003%

of the national population, which is a good representative of the adult population of urban and rural China in 2002.

Figures 2 shows that in rural and urban areas the average log hourly wage rate for men is much higher than for women. For urban individuals, men receive 12% more than women. The log wage rate for rural men is 39% higher than for women. Moreover, urban men earn a 105% higher wage rate than rural men and the log wage rate for urban female workers is 154% higher than for rural women. The survey identifies two different ownership types of urban and rural work units: private and public. These designations are important because average wage rates differ across these work units. Figures 3 and Figure 4 show that the average hourly wage rates for urban men and women and rural men and women working in public sectors are much higher than those working in private sectors. Urban women who worked in public sectors receive 30% more than those who are employed in private sectors. The average log wage rate for urban men working in the public sector is 16% higher than those working in the private sector. For rural men employed in the public sector, the log wage rate is 44% higher than for those employed in the private sector. Women who work in the public sector are paid 80% more than those employed in the private sector. These differences are much larger than for the rural sector.

Table 1 and Table 2 provide short definitions of variables and summary statistics. Our urban sample consists of 12,024 individuals, 6,269 (52%) are men and 5,755 (48%) are women. The average age of men is 38.6 years old, and slightly larger than

the average age of women, which is 36.5 years old. The average amount of education is 11.4 years for men and 10.9 years for women. Annual hours of working for urban men are 2,274.4 hours, which is slightly larger than 2,208.3 annual hours of working for urban women.

Our rural sample consists of 27,126 individuals, 14,213(52%) are men and 12,913(48%) are women. The average age of men in rural China is 36.8 years old and 36.1 years old for women. Men and women have completed an average of 7.9 and 6.7 years of schooling, respectively. The education level for rural Chinese is much lower than urban Chinese. The average log real hourly wage in rural China is about one half of the log wage rate in urban China. The average hours of work for rural women and men are approximately 30% less than for workers in urban areas.

5 Empirical Results

Empirical results from fitting the labor force participation, wage and labor supply equations to the CHIP data for 2002 are presented and discussed. Separate equations are fitted for men and women and for rural and urban residents.

Table 3 controls the local fixed effect by adding provincial dummy variables and presents the estimated coefficients for fitting Probit model for labor force participation equation. The marginal effect of an individual becoming older is to increase the probability of working when he/she is young, but as he/she becomes older, the size of the marginal effect declines and becomes zero at 43.4 and 41.8 years of age for urban men and women, respectively, and 41.2 and 38.4 years for rural

men and women, respectively. When an individual is older than the appropriate value, the probability of him/her working declines as he or she ages. For urban men and women, the marginal effect of an additional year of education is to significantly increase his/her probability of working. However, in rural areas, the marginal effect of an additional year of male and female education is to reduce his/her probability of working in the market.

An increase in the family size significantly decreases the probability of working in the market for urban women. Rural men are more likely to work if the family size is large. One explanation is that women take primary responsibility for housework, such as raising children and doing the laundry; while working in the market is a stronger norm for men than women.

Being married significantly increases the probability of working in the market for urban men and rural men. The primary reason is that the financial cost of raising children, which makes the married males more likely to work.

Table A1 reports the marginal effects on labor participation for urban and rural Chinese fitting OLS model. The effects of age on probability of working firstly increases with age when the individual is young and then decreases as she/he gets older. Higher educated urban men and women are more likely to work but for rural men and women, those individuals with less education are more likely to participate in the labor markets.

Table 4 presents the estimated labor demand equations without selection for

urban men and women where the employer ownership type is permitted to be a factor explaining wage differences. The results in Table 4 suggest as an individual's age or experience rises, the wage rates for urban men and women increase but the magnitudes of the increases decline as the individual grows older. These results in Table 4 imply a positive return to experience in the form of higher wage rates for men and women in urban and rural China. The economic return to experience peaks at 56.1 years of age for urban men and 76.7 years of age for urban women. The wage rate peaks at 45.3 years of age for rural men and 50.0 years of age for women. The estimated return to a year of schooling is significantly higher for women than men and for urban than rural adults.

The schooling effects are statistically strong. For urban men, an additional year of education increases their wage by 5.3%. For urban women, the marginal effect of education is larger, 6.6% which is consistent with previous literatures that the economic return to women is larger than for men. For rural men the estimated return is 2.0% and for women is 2.4%. Hence, the return to a year of education in rural China is quite low, and we expect educated individuals initially living in rural areas to migrate for work to urban areas. In the urban labor market, an individual being employed in the public sector increases men's wage rate by 11.7% and women's wage rate by 18.6%. In the rural labor market, the wage rate is 16.1% higher for men and 17.2% for women when they are employed by the public sector.

Table 5 reports the estimates of the wage equation with selection and the

selection term is derived from Table 3. The estimated wage equations for three groups show statistically significant sample selection—as the probability of working in the market increases the wage rate increases and ignoring the selection term biased our estimates. The results suggest a positive economic return to experience and a positive economic return to education. However, the log wage increase due to one additional year of schooling remains low in rural areas and is about one half of the log wage in urban areas. Workers in the public sectors enjoy 12%-19% higher wage rates than those employed in private sectors.

Since wage rates differ by a large amount in 2002 in China, we permit the estimated wage elasticities of labor supply for low, medium and high wage individuals to differ and test for significant differences. Table 6 reports the point estimates of labor supply differed by gender region, and location of the individual in the wage distribution. The reference groups are Table 6 is for those individuals in the middle quarters of the wage distribution, respectively. Predicted wage rates for urban women and men and rural women and men are generated using estimates of the wage equation reported in Table 4. For urban men additional non-labor income reduces hours of work. The negative income effect on labor supply is significantly different from zero at the 1% level for urban men. The negative estimated coefficients imply leisure is a normal good. In contrast for rural men and women, the income effect on labor supply is positive which indicates that leisure is an inferior good.

One percent increase in the price of housing increases labor supply by 0.03% for

urban men, 0.02% for urban women, and 0.14% for rural men. The effects of housing price on the labor supply is significant at 1% level for urban men and rural men and at 5% level for urban women. These results suggest that these individuals work more when housing is more expensive and that leisure and housing are complements. One percent wage rate increase reduces the hours of work for medium-wage urban men by 0.06% and 0.07% for urban women, respectively. Urban men work 0.03% more hours due to one percent wage increase if their wage rates are low. Leisure is a normal good for highly-paid men and women in urban areas of China. The differentials between medium-wage and high-wage individuals as well as the differentials between low-wage and medium-wage in urban China are significant at 1% significance level. For rural men and women, one percent increase in wage rate increases labor supply by 0.07% and 0.39% if they earn medium-wage rates, respectively. Low-wage men and women work more: 0.37% for men and 0.62% for women.

Moreover, these results help to rationalize the difference in the wage elasticity of labor supply across the distribution of wage rates, i.e., for high wage individuals in urban areas of China, they do not need to work as many hours to pay for housing and as a result have a negatively sloped labor supply curve.

Urban men who are married work more than those who are unmarried. However, for rural men and women, being married reduces their labor supply. A larger family size tends to increase labor supply for men in urban areas. Selection is statistically significant in the labor supply equations for urban men and women and rural women.

We then calculate the wage elasticities using the estimated coefficients reported in Table 6. The wage elasticities of labor supply for urban men and women who earn medium-wage rate are negative, -0.057 and -0.067, respectively. In contrast, for rural women and men, the wage elasticities of labor supply are positive, 0.066 for men and 0.391 for women. Hence, women's labor supply elasticities for mid-wage individuals in rural and urban labor markets are larger than male's labor supply elasticities for mid-wage individuals. The point estimates for these labor supply elasticities are -0.057, -0.067, 0.066 and 0.391 for reference group urban men and women and rural men and women (medium-paid), respectively. When an individual is in the lower quarter of the wage distribution, his/her wage elasticity of labor supply is 9% to 31% larger than for those individuals who get paid medium wage. For the bottom quarter of urban men and women and rural men and women), their wage elasticities of labor supply are 0.029, 0.027, 0.374, and 0.624, respectively. The wage elasticities of labor supply for those adults in the upper quarter of wage distribution are smaller: -0.115, -0.147, 0.077 and 0.306 for urban men and women and rural men and women, respectively. For the low-wage urban men and women as well as rural men and women, their hours of work rise with the wage rate. The wage elasticities for the low-wage urban men and women and rural men and women, are all positive, which indicates that the low-wage individuals have to work long hours to compensate for living costs. However, the sign of the wage elasticities of labor supply for urban and rural high-paid individuals are opposite: when their wages rate are high, the high-

wage rural men and women work longer hours but in urban areas men and women work less. The leisure is a normal good for urban high-wage men and women but an inferior good for rural high-wage men and women.

Angrist (2002) discussed the effect of sex ratios on the labor market in United States. We test whether the sex ratios affect the labor participation decisions for urban and rural Chinese. Table 8 reports the estimates for fitting Probit model for labor participation equation in which the sex ratio variable instead of provincial dummies is used to control for the location-specific fixed effects. Table A5 reports the estimated coefficients fitting OLS model for labor force participation. Table 8 shows that the effects of local sex ratios are insignificant at 10% level for urban men and women while the sex ratio has significant effects on the labor participation rate for rural men and women. For urban men and women and rural men and women, the probability of working increases as the young individual gets elder. However the magnitude of the positive effect decreases. Higher educated individuals are more likely to work in urban China while low educated rural men are women have a higher probability of working.

Table 9 report the estimation for fitting wage equation with the selection term calculated from Table 8. We find the effects of selection are significant at 1% significance level for urban men and rural men and at 5% significance level for rural women. From Table 9, the economic return to experience and education are positive and significant at 1% level. Moreover, the economic return to education in urban

China is 78% and 133% more for men and women working in urban China than those working in rural areas, respectively. Urban men and women in public sectors earn 12% and 19% higher wage than those who are employed in private sectors. The wage rates for rural men and women in the public sectors are 16% and 17% higher than those working in private sectors.

Predicted wage rates for urban and rural women and men are generated using estimates of the wage equation reported in Table 4. We find significant wage effects for urban and rural individuals. For the reference group who get medium-wages, 1% wage rate increase reduces the labor supply by 0.06% and 0.04% for urban men and women, respectively. For high-wage workers in urban areas, men work 0.12% and women work 0.12% fewer hours if the wage rate rises by 1%. For rural medium-wage individuals, their labor supplies increases by 0.09% for men and 0.40% for women with one percent increase in wage rates. For low-wage rural men and women, they work 0.40% and 0.62% more for men and women as their wage rates rise by 1%.

Urban men and women and rural men work longer hours when the housing price is high: urban men work more by 0.03%, urban women work more by 0.02% and rural men work more by 0.13% with a one percent housing price increase. The effects of housing price on labor supply is significant at 1% level for urban and rural men and at 10% level for urban women.

Table A2 and A3 report the results for estimating the wage and labor supply equation where the selection term is estimated by applying OLS model and with

location dummies. Table A6 and A7 report the results for estimating the wage and labor supply equation where the selection term is estimated by applying OLS model and with sex ratios.

6 Conclusions

In this paper, we use the individual data from the 2002 Chinese Household Income Project (CHIP),which collected data from households in twelve provinces in urban China and twenty-two provinces in rural China, to examine decisions of an individual of working, wage while working, and labor supply. We develop an econometric model with housing price variable incorporated to empirically examine the effects of housing prices on the labor supply for Chinese men and women in rural and urban areas based on the Chinese Household Income Project in 2002. We find a number of differences between women and men and between rural and urban areas for a given gender. First, the economic return to education through the wage rate for market work is statistically positive and large for urban women and men but smaller for rural women and men. Second, the wage equations contain a concave age-experience effect confirming positive returns to experience up to late middle-age. Third, wage rates are significantly higher (12%-19%) for those adults working in the public sector.

Fourth, the wage elasticity of labor supply differs across men and women, rural and urban areas, and location of the individual in the wage distribution. The wage elasticity of labor supply is larger for rural than urban individuals of a given gender

except urban high wage men, and for women than for men except for urban low wage rate individuals. Our empirical results show that the wage elasticities of labor supply are positive for low-wage urban men and women and rural men and women; for the high-wage urban men and women, their hours of work decline with their wage rates but high-wage rural men and women work more when the wage rates are high.

Fifth, a higher average real price of housing increases labor supply for urban and rural men suggesting that leisure and housing are complements and those male adults work more hours in the market where housing is more expensive.

References

Angrist, J., 2002. *How do sex ratios affect marriage and labor markets? Evidence from America's second generation*, Quarterly Journal of Economics, *997-1038*

Apps P. and Savage E.,1989. *Labour Supply, Welfare Ranking and the Measurement of Inequality*, Journal of Public Economics 39:335-364

Berger M.C., Blomquist G.C., Peter K.S., 2008. *Compensating differentials in emerging labor and housing markets: Estimates of quality of life in Russian cities*, Journal of Urban Economics 63: 25–55

Bleisher B.M., Yin Y. and Hills S.M., 1997. *The role of housing privatization and labor-market reform in China's dual economy*, China Economic Review, Volumn 8(1)

Byron R. P. and Manaloto E. Q., 1990. *Returns to Education in China*, Economic Development and Cultural Change, Vol. 38, No. 4, pp. 783-796

Cain G. G. and Dooley M. D., 1976. *Estimation of a Model of Labor Supply, Fertility, and Wages of Married Women*, Journal of Political Economy, Vol. 84, pp S179-S200

Cameron L. A., Dowling J. M., and Worswick C., 2001. *Education and Labor Market Participation of Women in Asia: Evidence from Five Countries, Economic Development and Cultural Change*, Vol. 49, No. 3, pp. 459-477

Chen G., Hamori S., 2009. *Economic returns to schooling in urban China: OLS and the instrumental variables approach*, China Economic Review, 20, 143-152

Costa, Dora L., 2000. *The Wage and the Length of the Work Day: From the 1890s to 1991*. Journal of Labor Economics 18(1): 156-181

Davidoff T., 2006. *Labor income, housing prices, and homeownership*, Journal of Urban Economics 59 (2006) 209–235

Démurger, S.,Li S., Yang J., 2012, *Earnings differentials between the public and private sectors in China: Exploring changes for urban local residents in the 2000s*, China Economic Review,Volume 23, Issue 1, Pages 138–153

Deutsch E. Neuwirth N. and Yurdakul A., 2001. *Housing and Labor Supply*, Journal of Housing Economics 10, 335–362 (2001)

Fields G. S., 1994. *Changing Labor Market Conditions and Economic Development in Hong Kong, the Republic of Korea, Singapore, and Taiwan, China*, The World Bank Economic Review, Vol. 8, No. 3 (Sep., 1994), pp. 395-414

Fisher W., 2000. *Labor Supply Effects of Federal Rental Subsidies*, Journal of Housing Economics 9, 150–174

Fleisher B. and Wang X., 2004. *Skill differentials, return to schooling, and market segmentation in a transition economy: the case of Mainland China*, Journal of Development Economics, Volume 73, Issue 1, Pages 315-328

Fortin N., 1995. *Allocation Inflexibilities, Female Labor Supply, and Housing Assets Accumulation: Are Women Working to Pay the Mortage?* Journal of Labor Economics,Vol. 13, No. 3, pp. 524-557

Gindling T.H. and Sun W., 2002. *Higher education planning and the wages of workers with higher education in Taiwan*, Economics of Education Review, Volume 21, Issue 2, Pages 153–169

Goodman C.A., 1988. *An Econometric Model of Housing Price, Permanent Income, Tenure Choice, and Housing Demand*, Journal of Urban Economics 23, 327-353

Gustafsson B., Li S., 2000. *Economic transformation and the gender earnings gap in urban China*, Journal of Population Economics, 13: 305-329

Haurin D., 1991. *Income Vriability, Homeowenership, and Housing Demand*, Journal of Housing Economics 1, 60-74

Heckman J.J., 1979. *Sample selection bias as a specification error*. Econometrica, 153-161.

Heckman J.J., 1993. *What has been learned about labor supply in the past twenty years?* The American Economic Review, Vol. 83, No.2 pp.116-121

Hill M. A., 1989. *Female Labor Supply in Japan: Implications of the Informal Sector for Labor Force*, Journal of Human Resources, Vol.24, pp. 143-161

Huffman W.E. and Feridhanusetyawan T., 2007. *Migration, Fixed Costs, and Location-Specific Amenities: A Hazard Analysis for a Panel of Males*, American Journal of Agricultural Economics, 89(2):368-382

Ilmakunnas S. and Pudney S., 1990. *A model of female labour supply in the presence of hours restrictions*, Journal of Public Economics 41, 183-210

Johnson W.R., 2014. *House prices and female labor force participation*, Journal of Urban Economics 82:1-11

Knight J., Song L., 2003. *Increasing urban wage inequality in China*, Economics of Transition, Volume 11, Issue 4, pages 597–619

Lee B.S., Jang S., Sarkar J., 2008. *Women's labor force participation and marriage: The case of Korea*, Journal of Asian Economics, Volume 19, Issue 2, Pages 138–154

Li H. and Zax J. S., 2003. *Labor supply in urban China*, Journal of Comparative Economics 31, 795-817

Liu P., Meng X., Zhang J., 2000. *Sectorial gender wage differentials and discrimination in the transitional Chinese economy*, Journal of Population Economics, 13: 331-352

Mayo S. K. and Stein J., 1995. *Housing and Labor market Distortions in Poland: Linkages and Policy Implications*, Journal of Housing Economics 4, 153-182

Pencavel J., 1998. *The Market Behavior and Wages of Women: 1975-94*, The Journal of Human Resources. Vol. 33. No. 4

Pencavel J., 2002. *The Cohort Analysis of the Association between Work hours and Wages among Men*, The Journal of Human Resources. Vol. 37. No. 2

Rupert and Wasmer., 2012. *Housing and the labor market: Time to move and aggregate unemployment,* Journal of Monetary Economics 59, 24-36

Sasaki M., 2002. *The Causal Effect of Family Structure on Labor Force Participation among Japanese Married Women*, The Journal of Human Resources, Vol. 37, No. 2, pp. 429-440

Shi, Li. *Chinese Household Income Project*, 2002. ICPSR21741-v1. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2009-08-14. http://doi.org/10.3886/ICPSR21741.v1

Wei S. and Zhang X., 2011. *The Competitive Saving Motive: Evidence from Rising Sex Ratios and Savings Rates in China*, Journal of Political Economy, Vol. 119, No. 3 pp. 511-564

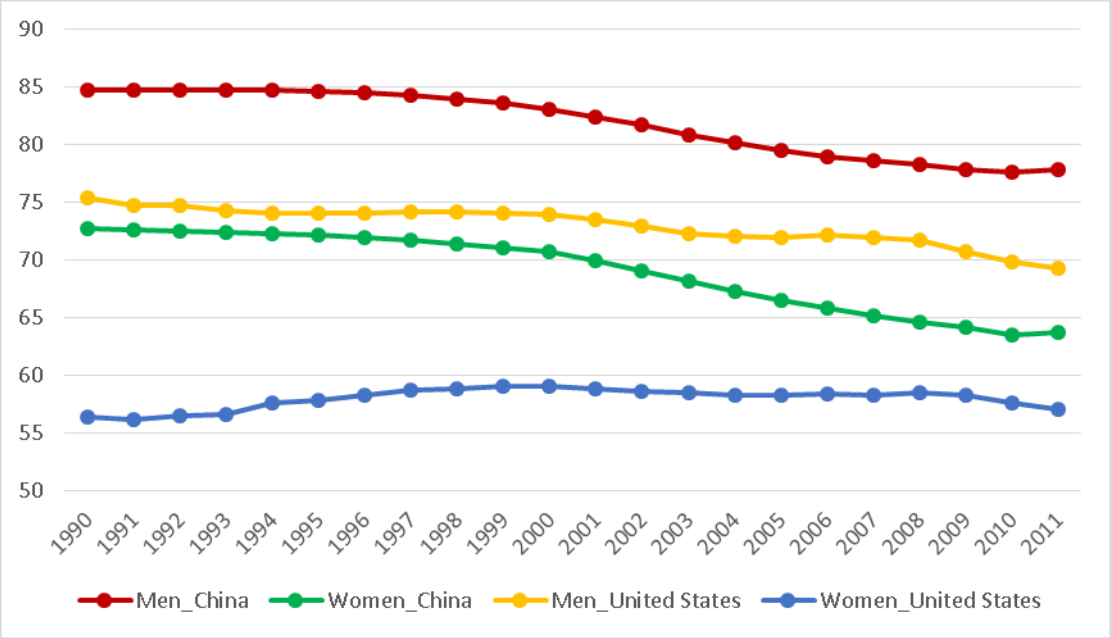
Yoshikawa and Ohtake., 1989. *An analysis of female labor supply, housing demand and the saving rate in Japan*, European Economic Review 997-1030

Zhang L., Brauw A. D. , Rozell S., 2004. *China's rural labor market development and its gender implications*, China Economic Review, Volume 15, Issue 2, Pages 230–247

Zhang J., Zhao , Y. , Park A., Song X., 2005. *Economic returns to schooling in urban China, 1988-2001*, Jorunal of Comparative Economics, 730-752

Zenou Y., 2000. *Urban unemployment, agglomeration and transportation policies*, Journal of Public Economics 77, 97-133

Figure 1. Labor participation rate (%)



Resource: World Bank

Figure 2. Average Log Hourly Real Wage Rate in Urban and Rural China (Yuan), 2002

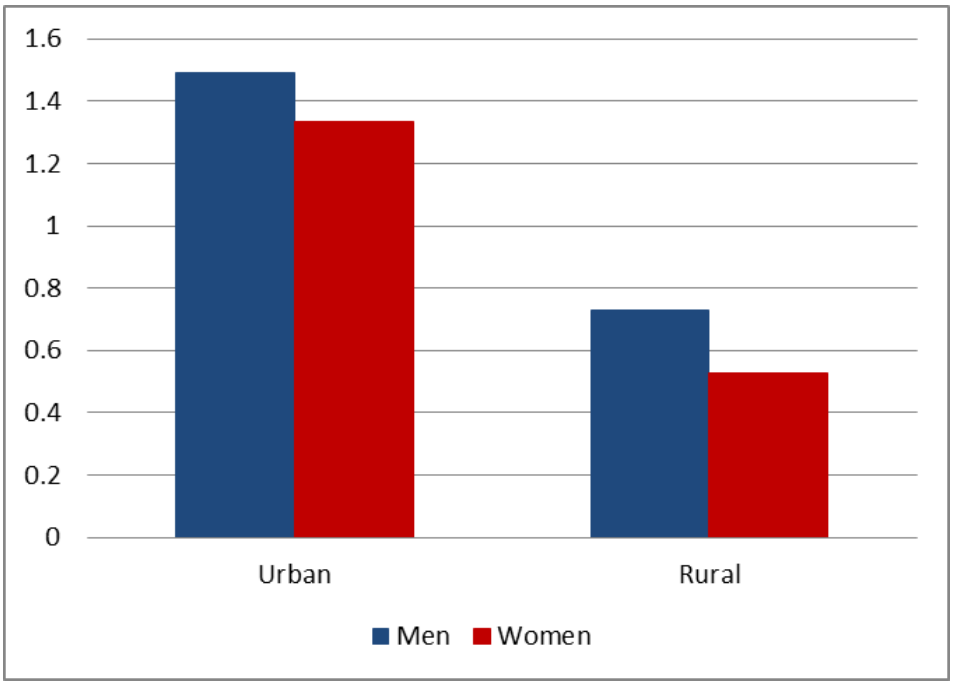


Figure 3. Average Log Hourly Real Wage Rate in Urban China (Yuan), 2002

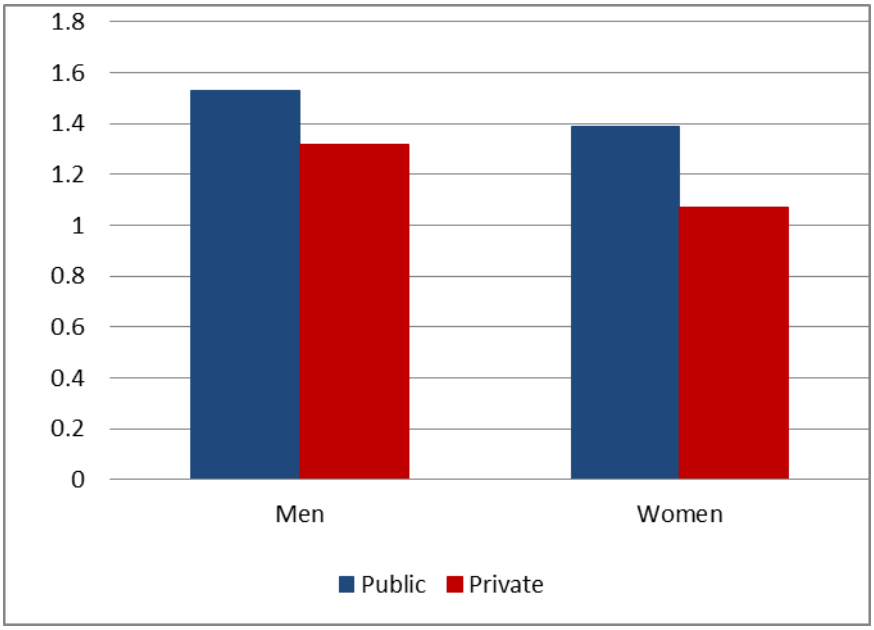


Figure 4. Average Log Hourly Wage Rate in Rural China (Yuan), 2002

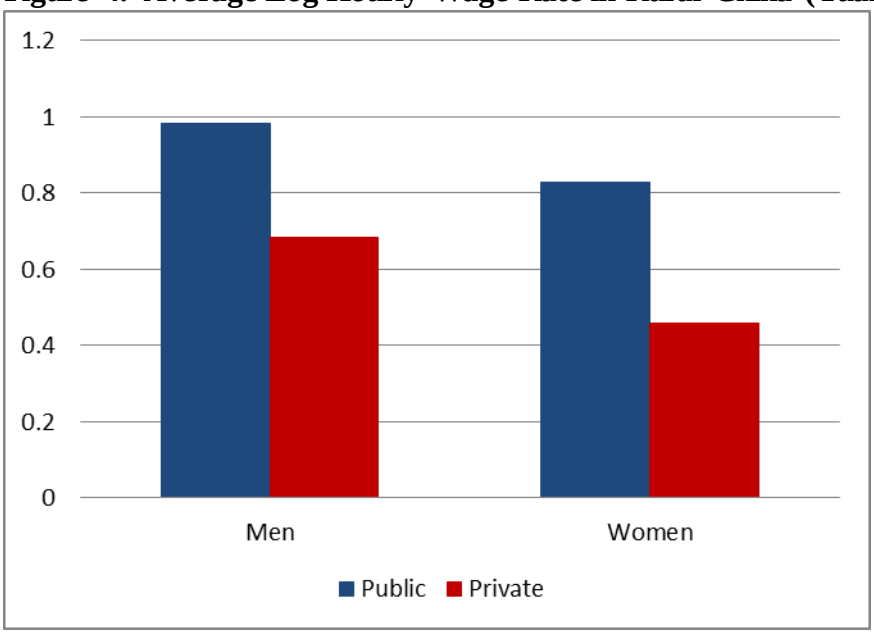


Table 1. Variable Definitions and Descriptive Statistics for Urban Chinese, 2002

Variables	Definitions	Men(N=6,269) Mean(SD)	Women(N=5,755) Mean(SD)
Age	Years of age	38.636(11.808)	36.545(11.076)
Age-squared/100	Age squared/100	16.321(8.788)	14.582(8.064)
Education	Years of education	11.400(3.062)	10.899(3.204)
Married	1 if the individual is married; 0 otherwise	0.760(0.427)	0.757(0.429)
Family Size	Numbers of family members in the household	3.211 (0.751)	3.244 (0.799)
Work status	1 if the individual works; 0 otherwise	0.793(0.405)	0.675(0.468)
ln Wage	Logarithm of real hourly wage rate	1.493(0.607)	1.334(0.631)
Hour of work	Annual hours of work	2,274.4(617.0)	2,208.3(621.8)
Wage income	Annual wage income	10,491.7(8,412.5)	7,921.8(6,544.7)
ln NonlaborIncome	Logarithm of Annual nonlabor income	9.273(1.418)	9.508(1.094)
Ownership type of employer:			
Private Sector	1 if the individual works in Private sector; 0 otherwise	0.061(0.239)	0.050(0.219)
Public Sector	1 if the individual works in Public sector; 0 otherwise	0.647(0.478)	0.545(0.498)
ln housing price	ln average area real housing price	3.223(0.471)	3.169(0.524)
Sex ratio	The sex ratio of men to women	104.596(3.099)	104.602(2.970)

Table 2. Variable Definitions and Descriptive Statistics for Rural Chinese, 2002

Variables	Definitions	Men(N=14,213) Mean(SD)	Women(N= 12,913) Mean(SD)
Age	Years of age	36.762(13.582)	36.081 (13.018)
Age-squared/100	Age squared/100	15.359(10.342)	14.713 (9.712)
Education	Years of education	7.875(2.500)	6.682(2.985)
Married	1 if the individual is married; 0 otherwise	0.698(0.459)	0.745(0.436)
Family Size	Numbers of family members in the household	4.429(1.368)	4.509(1.362)
Work status	1 if the individual works;0 otherwise	0.839(0.367)	0.744(0.436)
ln Wage	Logarithm of real hourly wage rate	0.728(0.856)	0.525(0.798)
Hours of work	Annual hours of work	1,502.6(946.1)	1,735.7(990.5)
Wage income	Annual wage income	3,783.3(4,574.8)	3,568.2(3,531.8)
ln NonlaborIncome	Logarithm of annual nonlabor income	4.019(4.042)	5.878(3.619)
Private Sector	1 if the individual works in Private sector; 0 otherwise	0.265(0.441)	0.148(0.355)
Public Sector	1 if the individual works in Public sector; 0 otherwise	0.064 (0.244)	0.031(0.172)
ln housing price	ln average area real housing price	2.281(0.494)	2.284(0.497)
Sex ratio	The sex ratio of men to women	104.485(2.502)	104.422(2.514)

Table 3. The Marginal Effects on Labor Force Participation for Men and Women, Urban and Rural Chinese, 2002 (Probit)

	Urban		Rural	
Regressors	Men	Women	Men	Women
Age	0.053***	0.087***	0.047***	0.056***
	(0.002)	(0.004)	(0.001)	(0.002)
Age-squared/100	-0.061***	-0.104***	-0.057***	-0.073***
	(0.003)	(0.004)	(0.002)	(0.003)
Education	0.014***	0.036***	-0.008***	-0.003*
	(0.001)	(0.002)	(0.001)	(0.001)
ln Nonlabor Income	0.004	-0.013**	-0.003***	-0.007***
	(0.003)	(0.006)	(0.001)	(0.001)
Married	0.083***	0.026	0.030***	0.010
	(0.014)	(0.019)	(0.009)	(0.014)
Family size	-0.005	-0.019***	0.005**	0.006**
	(0.005)	(0.006)	(0.002)	(0.003)
Prob>Chi2	0.0000	0.0000	0.0000	0.0000

Note 1. *significant at 0.1; ** significant at 0.05; *** significant at 0.01

Note 2. Provincial dummy variables are included.

Table 4. Estimation of log wage without selection for Men and Women, Urban and Rural Chinese, 2002

VARIABLES	Urban		Rural	
	Men	Women	Men	Women
Age	0.046***	0.023***	0.068***	0.033***
	(0.007)	(0.009)	(0.005)	(0.009)
Age-squared/100	-0.041***	-0.015	-0.075***	-0.033***
	(0.008)	(0.011)	(0.007)	(0.013)
Education	0.053***	0.066***	0.020***	0.024***
	(0.003)	(0.003)	(0.004)	(0.006)
Public	0.117***	0.186***	0.161***	0.172***
	(0.022)	(0.026)	(0.029)	(0.042)
Constant	0.031	0.183	-0.523***	-0.132
	(0.143)	(0.171)	(0.125)	(0.172)
R^2	0.195	0.225	0.155	0.215

Note 1.*significant at 0.1; ** significant at 0.05; *** significant at 0.01
Note 2. Provincial dummy variables are included.

Table 5. Estimation of log wage with selection (Probit) for Men and Women, Urban and Rural Chinese, 2002

VARIABLES	Urban		Rural		Urban		Rural	
	Men	Women	Men	Women	Men	Women	Men	Women
Age	0.009***	0.011***	0.006***	0.008***	0.043***	0.029	0.065***	0.038
	(0.001)	(0.001)	(0.001)	(0.002)	(0.016)	(0.025)	(0.013)	(0.024)
Age-squared/100					-0.038**	-0.022	-0.071***	-0.040
					(0.019)	(0.030)	(0.015)	(0.032)
Education	0.048***	0.063***	0.026***	0.025***	0.053***	0.069***	0.020***	0.023***
	(0.003)	(0.004)	(0.004)	(0.006)	(0.004)	(0.008)	(0.005)	(0.006)
Public	0.118***	0.187***	0.163***	0.174***	0.117***	0.186***	0.161***	0.172***
	(0.022)	(0.026)	(0.029)	(0.042)	(0.022)	(0.026)	(0.029)	(0.042)
Selection	0.330***	0.090	0.881***	0.332**	0.036	-0.057	0.059	-0.085
	(0.071)	(0.077)	(0.088)	(0.145)	(0.162)	(0.211)	(0.199)	(0.370)
Constant	0.554***	0.387***	-0.113	0.095	0.075	0.080	-0.508***	-0.176
	(0.069)	(0.079)	(0.105)	(0.128)	(0.246)	(0.416)	(0.135)	(0.256)
R^2	0.194	0.225	0.153	0.215	0.192	0.222	0.152	0.207

Note:*significant at 0.1; ** significant at 0.05; *** significant at 0.01

Note: The selection term is derived from Table 4.

Table 6. OLS Estimates of ln Hours Worked (Labor Supply) with Selection (Probit) for Chinese Men and Women, Urban and Rural China, 2002

VARIABLES	(1) Urban Men	(2) Urban Women	(3) Rural Men	(4) Rural Women
Predicted wage	-0.057***	-0.067**	0.066	0.391***
	(0.020)	(0.026)	(0.047)	(0.067)
D_{low}*Predicted ln wage	0.086***	0.094***	0.308***	0.233**
	(0.007)	(0.011)	(0.045)	(0.095)
D_{high}*Predicted ln wage	-0.058***	-0.080***	0.011	-0.085
	(0.007)	(0.009)	(0.034)	(0.062)
ln NonlaborIncome	-0.008***	-0.005	0.051***	0.033***
	(0.003)	(0.005)	(0.003)	(0.006)
ln housing price	0.029***	0.021**	0.135***	-0.021
	(0.008)	(0.010)	(0.027)	(0.045)
Married	0.040*	0.012	-0.291***	-0.585***
	(0.022)	(0.018)	(0.042)	(0.049)
Familysize	0.016***	0.004	0.012	0.018
	(0.006)	(0.007)	(0.010)	(0.015)
Selection	0.181***	0.079*	-0.067	0.238*
	(0.051)	(0.046)	(0.130)	(0.141)
Constant	7.498***	7.630***	6.595***	6.880***
	(0.050)	(0.058)	(0.123)	(0.154)
R^2	0.082	0.080	0.076	0.081

Note: *significant at 0.1; ** significant at 0.05; *** significant at 0.01

Note: The selection term is derived from Table 4.

Table 7. Wage Elasticities for Chinese Men and Women, Urban and Rural China, 2002

	Urban		Rural	
	Men	Women	Men	Women
Low-wage	0.029	0.027	0.374	0.624
Medium-wage	-0.057	-0.067	0.066	0.391
High-wage	-0.115	-0.147	0.077	0.306

Note: The wage elasticities are calculated using Table 6.

Table 8. The Marginal Effects on Labor Force Participation for Men and Women, Urban and Rural Chinese, 2002 (Probit)

	Urban		Rural	
Regressors	Men	Women	Men	Women
Age	0.053***	0.089***	0.048***	0.056***
	(0.002)	(0.004)	(0.001)	(0.002)
Age-squared/100	-0.061***	-0.106***	-0.058***	-0.073***
	(0.003)	(0.004)	(0.002)	(0.003)
Education	0.015***	0.037***	-0.009***	-0.009***
	(0.001)	(0.002)	(0.001)	(0.001)
ln Nonlabor Income	0.003	-0.007	-0.002***	-0.006***
	(0.003)	(0.005)	(0.001)	(0.001)
Married	0.081***	0.015	0.030***	0.009
	(0.014)	(0.019)	(0.009)	(0.014)
Family size	-0.005	-0.020***	0.004*	0.015***
	(0.005)	(0.006)	(0.002)	(0.003)
Sex ratio(male vs. female)	-0.001	0.002	0.004***	0.005***
	(0.001)	(0.002)	(0.001)	(0.001)
Prob>Chi2	0.0000	0.0000	0.0000	0.0000

Note:*significant at 0.1; ** significant at 0.05; *** significant at 0.01

Table 9. Estimation of log wage with selection (Probit) for Men and Women, Urban and Rural Chinese, 2002

VARIABLES	Urban		Rural		Urban		Rural	
	Men	Women	Men	Women	Men	Women	Men	Women
Age	0.010***	0.010***	0.005***	0.009***	0.048***	0.018	0.046***	0.079**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.017)	(0.027)	(0.017)	(0.032)
Age-squared/100					-0.044**	-0.009	-0.049**	-0.094**
					(0.019)	(0.032)	(0.020)	(0.043)
Education	0.048***	0.063***	0.027***	0.027***	0.054***	0.065***	0.023***	0.017**
	(0.003)	(0.004)	(0.004)	(0.006)	(0.004)	(0.009)	(0.005)	(0.007)
Public	0.118***	0.186***	0.161***	0.174***	0.117***	0.186***	0.161***	0.171***
	(0.022)	(0.026)	(0.029)	(0.042)	(0.022)	(0.026)	(0.029)	(0.042)
Selection	0.322***	0.105	0.971***	0.297**	-0.022	0.043	0.368	-0.737
	(0.071)	(0.078)	(0.090)	(0.146)	(0.168)	(0.228)	(0.264)	(0.494)
Constant	0.563***	0.393***	-0.242**	0.011	0.003	0.263	-0.444***	-0.294
	(0.069)	(0.079)	(0.109)	(0.148)	(0.256)	(0.458)	(0.137)	(0.203)
R^2	0.194	0.225	0.155	0.214	0.195	0.225	0.156	0.216

Note:*significant at 0.1; ** significant at 0.05; *** significant at 0.01

Note: The selection term is derived from Table 8.

Table 10. OLS Estimates of ln Hours Worked (Labor Supply) with Selection (Probit) for Chinese Men and Women, Urban and Rural China, 2002

VARIABLES	(1) Urban Men	(2) Urban Women	(3) Rural Men	(4) Rural Women
Predicted wage	-0.060***	-0.041*	0.087*	0.395***
	(0.021)	(0.024)	(0.048)	(0.067)
D_{low}*Predicted ln wage	0.086***	0.094***	0.310***	0.222**
	(0.007)	(0.011)	(0.045)	(0.095)
D_{high}*Predicted ln wage	-0.058***	-0.081***	0.008	-0.085
	(0.007)	(0.009)	(0.034)	(0.062)
ln NonlaborIncome	-0.008***	-0.007	0.050***	0.027***
	(0.003)	(0.005)	(0.003)	(0.006)
ln housing price	0.031***	0.020*	0.132***	-0.024
	(0.009)	(0.010)	(0.027)	(0.045)
Married	0.037*	0.027	-0.247***	-0.426***
	(0.022)	(0.018)	(0.045)	(0.062)
Familysize	0.016***	0.002	0.014	0.032**
	(0.006)	(0.007)	(0.010)	(0.015)
Selection	0.189***	0.007	-0.287*	-0.572**
	(0.053)	(0.044)	(0.151)	(0.236)
Constant	7.492***	7.667***	6.744***	7.366***
	(0.051)	(0.058)	(0.131)	(0.187)
R^2	0.082	0.079	0.076	0.082

Note: *significant at 0.1; ** significant at 0.05; *** significant at 0.01

Note: The selection term is derived from Table 8.

Table 11. Wage Elasticities for Chinese Men and Women, Urban and Rural China, 2002

	Urban		Rural	
	Men	Women	Men	Women
Low-wage	0.026	0.053	0.397	0.617
Medium-wage	-0.060	-0.041	0.087	0.395
High-wage	-0.118	-0.122	0.095	0.310

Note: The wage elasticities are calculated using Table 10.

Appendix:

Table A1. The Marginal Effects on Labor Force Participation for Men and Women, Urban and Rural Chinese, 2002 (OLS)

	Urban		Rural	
Regressors	Men	Women	Men	Women
Age	0.091***	0.105***	0.065***	0.064***
	(0.003)	(0.004)	(0.002)	(0.002)
Age-squared/100	-0.103***	-0.127***	-0.076***	-0.082***
	(0.003)	(0.005)	(0.002)	(0.003)
Education	0.015***	0.037***	-0.010***	-0.003*
	(0.001)	(0.002)	(0.001)	(0.001)
ln Nonlabor Income	0.003	-0.012**	-0.004***	-0.007***
	(0.003)	(0.005)	(0.001)	(0.001)
Married	0.131***	0.036*	0.033***	0.013
	(0.017)	(0.020)	(0.010)	(0.014)
Family size	-0.000	-0.023***	0.007***	0.007**
	(0.005)	(0.007)	(0.002)	(0.003)
R^2	0.481	0.352	0.272	0.174

Note 1. *significant at 0.1; ** significant at 0.05; *** significant at 0.01

Note 2. Provincial dummy variables are included.

Table A2. Estimation of log wage with selection (OLS) for Men and Women, Urban and Rural Chinese, 2002

VARIABLES	Urban		Rural		Urban		Rural	
	Men	Women	Men	Women	Men	Women	Men	Women
Age	0.009***	0.010***	0.004***	0.008***	-0.019	-0.047	-0.015	0.112***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.032)	(0.045)	(0.036)	(0.040)
Age-squared/100					0.031	0.068	0.022	-0.136**
					(0.036)	(0.054)	(0.042)	(0.053)
Education	0.048***	0.062***	0.029***	0.025***	0.044***	0.044***	0.032***	0.020***
	(0.003)	(0.004)	(0.004)	(0.006)	(0.005)	(0.015)	(0.007)	(0.006)
Public	0.117***	0.186***	0.163***	0.174***	0.117***	0.187***	0.164***	0.171***
	(0.022)	(0.026)	(0.029)	(0.042)	(0.022)	(0.026)	(0.029)	(0.042)
Selection	0.356***	0.133*	0.914***	0.296**	0.601**	0.620	1.178**	-1.225**
	(0.066)	(0.080)	(0.081)	(0.145)	(0.286)	(0.393)	(0.503)	(0.608)
Constant	0.565***	0.383***	-0.092	0.114	0.977**	1.300*	0.043	-0.844**
	(0.067)	(0.079)	(0.100)	(0.127)	(0.473)	(0.728)	(0.272)	(0.393)
R^2	0.195	0.226	0.156	0.214	0.196	0.226	0.156	0.216

Note:*significant at 0.1; ** significant at 0.05; *** significant at 0.01

Note: The selection term is derived from Table A1.

Table A3. OLS Estimates of ln Hours Worked (Labor Supply) with Selection (OLS) for Chinese Men and Women, Urban and Rural China, 2002

VARIABLES	(1) Urban Men	(2) Urban Women	(3) Rural Men	(4) Rural Women
Predicted wage	-0.046**	-0.075***	0.131**	0.139**
	(0.020)	(0.026)	(0.056)	(0.068)
D_{low}*Predicted ln wage	0.082***	0.091***	0.253***	0.280***
	(0.008)	(0.011)	(0.057)	(0.097)
D_{high}*Predicted ln wage	-0.058***	-0.081***	-0.137***	-0.055
	(0.007)	(0.009)	(0.039)	(0.059)
ln NonlaborIncome	-0.008***	-0.003	0.139***	0.195***
	(0.003)	(0.005)	(0.015)	(0.020)
ln housing price	0.012**	0.002	0.098***	-0.027
	(0.005)	(0.007)	(0.036)	(0.047)
Married	0.043**	0.002	-0.127***	-0.439***
	(0.022)	(0.019)	(0.048)	(0.052)
Familysize	0.015***	0.005	-0.008	0.040***
	(0.006)	(0.007)	(0.012)	(0.015)
Selection	0.111**	0.119**	-0.417***	0.004
	(0.048)	(0.049)	(0.122)	(0.146)
Constant	7.617***	7.658***	6.289***	5.727***
	(0.044)	(0.055)	(0.167)	(0.214)
R^2	0.080	0.081	0.078	0.122

Note:*significant at 0.1; ** significant at 0.05; *** significant at 0.01

Note: The selection term is derived from Table A1.

Table A4. Wage Elasticities for Chinese Men and Women, Urban and Rural China, 2002

	Urban		Rural	
	Men	Women	Men	Women
Low-wage	0.036	0.016	0.384	0.419
Medium-wage	-0.046	-0.075	0.131	0.139
High-wage	-0.104	-0.156	-0.006	0.084

Note: The wage elasticities are calculated using Table A3.

Table A5. The Marginal Effects on Labor Force Participation for Men and Women, Urban and Rural Chinese, 2002 (OLS)

	Urban		Rural	
Regressors	Men	Women	Men	Women
Age	0.091***	0.107***	0.065***	0.063***
	(0.003)	(0.004)	(0.002)	(0.002)
Age-squared/100	-0.103***	-0.128***	-0.076***	-0.082***
	(0.003)	(0.005)	(0.002)	(0.003)
Education	0.015***	0.037***	-0.011***	-0.009***
	(0.001)	(0.002)	(0.001)	(0.001)
ln Nonlabor Income	0.003	-0.006	-0.003***	-0.006***
	(0.003)	(0.005)	(0.001)	(0.001)
Married	0.127***	0.024	0.031***	0.011
	(0.017)	(0.020)	(0.010)	(0.015)
Family size	0.000	-0.023***	0.007***	0.016***
	(0.005)	(0.007)	(0.002)	(0.003)
Sex ratio(male vs. female)	-0.001	0.001	0.004***	0.005***
	(0.001)	(0.002)	(0.001)	(0.001)
R^2	0.478	0.345	0.255	0.108

Note:*significant at 0.1; ** significant at 0.05; *** significant at 0.01

Table A6. Estimation of log wage with selection (OLS) for Men and Women, Urban and Rural Chinese, 2002

VARIABLES	Urban		Rural		Urban		Rural	
	Men	Women	Men	Women	Men	Women	Men	Women
Age	0.009***	0.010***	0.004***	0.009***	-0.018	-0.141***	-0.050	0.125***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.032)	(0.053)	(0.045)	(0.037)
Age-squared/100					0.030	0.180***	0.063	-0.154***
					(0.036)	(0.063)	(0.052)	(0.049)
Education	0.048***	0.061***	0.030***	0.027***	0.044***	0.011	0.039***	0.009
	(0.003)	(0.004)	(0.004)	(0.006)	(0.005)	(0.018)	(0.008)	(0.008)
Public	0.117***	0.185***	0.162***	0.174***	0.118***	0.187***	0.164***	0.171***
	(0.022)	(0.026)	(0.029)	(0.042)	(0.022)	(0.026)	(0.029)	(0.042)
Selection	0.357***	0.154*	0.922***	0.270*	0.598**	1.469***	1.681***	-1.440**
	(0.066)	(0.082)	(0.082)	(0.145)	(0.294)	(0.467)	(0.632)	(0.567)
Constant	0.573***	0.393***	-0.191*	0.029	0.980**	2.914***	0.108	-0.481**
	(0.067)	(0.079)	(0.105)	(0.147)	(0.489)	(0.885)	(0.268)	(0.220)
R^2	0.195	0.226	0.156	0.214	0.195	0.227	0.156	0.217

Note:*significant at 0.1; ** significant at 0.05; *** significant at 0.01

Note: The selection term is derived from Table A5.

Table A7. OLS Estimates of ln Hours Worked (Labor Supply) with Selection (OLS) for Chinese Men and Women, Urban and Rural China, 2002

VARIABLES	(1) Urban Men	(2) Urban Women	(3) Rural Men	(4) Rural Women
Predicted wage	-0.053***	-0.049**	0.131***	0.403***
	(0.021)	(0.025)	(0.049)	(0.067)
D_{low}*Predicted ln wage	0.086***	0.094***	0.313***	0.219**
	(0.007)	(0.011)	(0.045)	(0.095)
D_{high}*Predicted ln wage	-0.058***	-0.081***	0.003	-0.086
	(0.007)	(0.009)	(0.034)	(0.061)
ln NonlaborIncome	-0.008***	-0.006	0.047***	0.025***
	(0.003)	(0.005)	(0.003)	(0.006)
ln housing price	0.030***	0.020**	0.123***	-0.026
	(0.009)	(0.010)	(0.027)	(0.045)
Married	0.051**	0.022	-0.159***	-0.369***
	(0.022)	(0.018)	(0.045)	(0.063)
Familysize	0.016***	0.003	0.018*	0.036**
	(0.006)	(0.007)	(0.010)	(0.015)
Selection	0.134***	0.033	-0.649***	-0.823***
	(0.050)	(0.046)	(0.135)	(0.236)
Constant	7.525***	7.652***	6.975***	7.510***
	(0.049)	(0.059)	(0.119)	(0.186)
R^2	0.081	0.079	0.079	0.085

Note: *significant at 0.1; ** significant at 0.05; *** significant at 0.01

Note: The selection term is derived from Table A5.

Table A8. Wage Elasticities for Chinese Men and Women, Urban and Rural China, 2002

	Urban		Rural	
	Men	Women	Men	Women
Low-wage	0.042	-0.005	0.488	0.486
Medium-wage	-0.057	-0.111	0.288	0.343
High-wage	-0.086	-0.138	0.236	0.246

Note: The wage elasticities are calculated using Table A7.

CHAPTER 3

AN ECONOMETRIC ANALYSIS OF HOUSEHOLD EXPENDITURES WITH WELFARE COMPARISONS: NEW EVIDENCE FOR CHINESE URBAN AND RURAL HOUSEHOLDS

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Abstract

This paper examines Chinese rural and urban household expenditures on goods and services using an Almost Ideal Demand System (AIDS) fitted to provincial-level aggregate data over 2002-2011 and uses the estimated coefficients to provide estimates of income and price elasticities of demand for commodity groups. We use these estimates to make welfare comparisons over time for rural and urban households. Among our findings are that the income elasticity of demand for food is surprisingly large, but less than one, and the own-price elasticity of demand for food is small but larger for urban than rural households. Our preferred rural-urban household welfare comparison shows that the welfare growing at approximately 1% per year for urban Chinese households and 1.5% for rural Chinese households and with a small amount of convergence (4%) over the study period.

1 Introduction

Significant socio-economic disparities on income and expenditures exist between rural and urban China. In 2002, the annual disposable income per capita for urban households was 7,702.8 Yuan, which was 211% higher than for rural households of 2,475.6 Yuan. From 2002 to 2011, inequality of annual income per capita between urban and rural households increased from 5,227.2 to 14,832.53 Yuan. China is a large country with great differences in economic structures and transportation systems, and rural and urban differences are expected in the price and income elasticity of demand for goods and services and in the household welfare.

Aggregate demand studies of Chinese households have been undertaken by Fan et al. (1995) and He and Li (2010). Fan et al. (1995) disaggregated complete household expenditures into food, clothing, fuel, housing and others and fitted a linear expenditure system to provincial data for rural households over 1982-1990. Their results showed that the demand for food, clothing, fuel, and housing were price-inelastic. In addition, they found that food and clothing were necessities (income elasticity less than one but greater than zero) and housing was a luxury good (income elasticity greater than one). He and Li (2010) used cross-sectional provincial urban household expenditure data for 2002 from the Chinese Household Income Project (CHIP) to fit a quadratic AIDS. They also found that food and clothing were necessities and housing was a luxury good. In addition, healthcare was a luxury good. However, limited research has been undertaken on disaggregated total household expenditures of Chinese rural and urban households using recent provincial panel data and for urban-rural welfare comparisons.[1]

[1] Hovhannisyan and Gould (2013) have completed a structural analysis of disaggregated urban food

The objective of this paper is to examine rural and urban households' demand for goods and services over a recent period, 2002-2011, using a semi-complete household expenditure system, and to use the estimated coefficients of these systems to shed light on the extent of welfare improvements of rural and urban households over the study period and on the rural-urban household welfare differential.[2] Our model of household consumption builds on research by Deaton and Muellbauer (1980a,b), Huffman and Johnson (2004) and Huffman (2011), who use an almost-ideal-demand-system (AIDS). Our data for rural and urban provincial aggregates for households are collected in the Chinese Urban and Rural Household Survey by the National Bureau of Statistics of China. We fit a linear AIDS (LA-AIDS) to estimate the structure of aggregate household demand for an expenditure system that has six commodity groups—food & drinks, clothing & footwear, housing, transportation & communication, healthcare, and recreation. These commodity groups cover more than 90% of total household expenditures, and hence, comprise a semi-complete household expenditure system. Each of these commodity groups is important to Chinese households. The expenditure shares have changed over time, and rural-urban household differences exist.

The results show a surprisingly large income elasticity of demand for food and drink of urban households (0.91) and rural households (0.77). For urban households, transportation & communication and recreation are luxury goods, having income elasticities of 1.84 and 1.38, respectively. Also, urban households have an income elasticity of demand for healthcare of 0.99, and for housing of 0.89. In contrast for rural

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demand in provincial data over 2002-2010. They conclude that significant structural change occurred over the period in some of the seven food groups.

[2] Another strand of the literature has summarized Chinese rural-urban household differences using household income, per capita GDP or per capital consumption (Yang 1999, Yao and Zhang 2001, Lu 2002, Lu and Chen 2006, Terry et al. 2007 and Fleisher et al. 2010).

households, the goods with the largest income elasticities are transportation & communication (1.32). The income elasticity for healthcare is 1.12, which is a little larger than for urban households.

The (compensated own) price elasticity of demand for food and drink is larger for urban (-0.26) than for rural (-0.20) households. The price elasticity for clothing&footwear is considerably larger for rural (-1.39) than for urban (-1.14) households. The price elasticity for housing is somewhat smaller in urban households than rural households: -0.79 vs. -1.01, respectively. The price elasticity for healthcare is smaller for urban households (-0.68) than for rural households (-1.27). The price elasticity of demand for transportation & communication are smaller for urban than rural households: -0.63 vs. -1.44. The price elasticity for recreation is much larger for urban than rural households, -1.20 vs. -0.60. In addition, we provide new evidence of a modest narrowing of welfare differences between urban and rural households.

This paper is structured as follows: Section 1 documents recent research on demand for food and other goods and the application of LA-AIDS in China and other demand system. Section 2 provides the newly developed LA-AIDS for the estimation. Section 3 provides a brief description of the data; Section 4 presents the empirical results and Section 5 presents the welfare comparison in urban and rural China in 2002-2011. And Section 6 provides conclusions.

2 The Economic and Econometric Model

This section lays out the household demand system. It builds on the prior research of Deaton and Muellbauer (1980a, b), Huffman and Johnson (2004) and Huffman (2011). Their research uses the Almost Ideal Demand System (AIDS). The AIDS

cost/expenditure function gives the minimum expenditures $e(p_t, u_t)$ to attain a specific utility level u_t at the given commodity price p_t:

(1) $\ln e(p_t, u_t) = a(p_t) + u_t b(p_t)$ with

$$a(p_t) = \tilde{\alpha}_0 + \sum_i \tilde{\alpha}_i \ln p_{it} + \frac{1}{2}\sum_i \sum_i \tilde{\gamma}_{ij} \ln p_{it} \ln p_{jt}$$

$$b(p_t) = \beta_0 \prod_k p_{kt}^{\beta_k} \quad k=1,2,,,6.$$

where p_{kt} is the price index of commodity k (k = 1,2,,,6) at time t. Applying Shephard's lemma to (1) yields the equation for the budget share of commodity i:

$$s_{it} = \alpha_{i0} + \sum_{j=1}^{6} \gamma_{ij} \ln p_{it} + \beta_i \ln(Y_t / P_t^*)$$

where Y_t denotes the total expenditure and

$$\ln P_t^* = \alpha_0 + \sum_i \alpha_i \ln p_{it} + \frac{1}{2}\sum_i \sum_i \gamma_{ij} \ln p_{it} \ln p_{jt}$$

P_t^* is Stone's price index and $\gamma_{ij} = \frac{1}{2}(\tilde{\gamma}_{ij} + \tilde{\gamma}_{ji})$. We assume $\ln P_t^* \approx \sum_i s_{it} \ln p_{it}$ where $s_{it} = p_{it} x_{it} / Y_t$. When we make this substitution for the quadratic form in the logarithm of prices, we obtain the linear approximation to the AIDS, LA-AIDS.

The particular specification of the econometric LA-AIDS in this study is

(2) $$s_{it} = \alpha_{i0} + \sum_{j=1}^{6} \gamma_{ij} \ln p_{it} + \beta_i \ln(Y_t / P_t^*) + \tau_i t + \varepsilon_{it}$$

A trend is included in each equation, and it effectively de-trends the expenditure shares and all of the other regressors.[3] The disturbance term ε_{it} represents the effect of other

[3] By including a trend in the expenditure share equations, we capture some of the effects of omitted variables that are correlated with it, for example, data on the age distribution of the Chinese population in rural and urban areas is not available, and expenditure shares may be sensitive to a change in the age distribution of the population over time (Huffman 2011). Its inclusion also reduces the autocorrelation of

forces on the expenditure shares, and we permit it to have the first-order autocorrelation $\varepsilon_{it} = \rho\varepsilon_{it-1} + v_{it}$, but we restrict each share equation to have the same ρ value.[4] Across the population of households, we anticipate that $Ev_{it} = 0$.

From Deaton and Muellbauer (1980b), the adding-up constraints on expenditure shares, homogeneity and symmetry are imposed in the estimation of equation (2). These restrictions are as follows:

i) Adding up constraints: $\sum_i \alpha_i = 1$; $\sum_i \beta_i = 0$; $\sum_i \gamma_{ij} = 0$

ii) Homogeneity: $\sum_j \gamma_{ij} = 0$

iii) Symmetry: $\gamma_{ij} = \gamma_{ji}$.

The demand elasticities for LA/AIDS can be calculated from equation (2). The income/expenditure elasticity of demand for commodity i is: $\eta_{iM} = 1 + \beta_i / s_i$; the compensated own-price elasticity of demand for commodity i is: $\eta_{ii} = -1 + \gamma_{ii} / s_i + s_i$; and the compensated cross-price elasticity of demand for commodity i and the price of commodity j is: $\eta_{ij} = \gamma_{ij} / s_i + s_j$.

After estimation of the LA/AIDS model, the indirect utility can be evaluated using the following expression:

$$(3)\ u_t = (\ln e(p_t, u_t) - a(p_t)) / b(p_t) = \left[\ln e(p_t, u_t) - \sum_{i=1}^{6} s_{it} \ln p_{it} \right] / \beta_0 \prod_k p_{kt}^{\beta_k}$$

In particular, the estimated coefficients of the demand systems and average values of the variables across provinces in each year is to be used to estimate average household welfare from 2002-2011 for rural and urban households. This will permit us to shed new

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the residuals of the expenditure share equations.

[4] This is consistent with the system of share equations being estimated with cross-equation restrictions.

light on the magnitude of rural and urban household welfare improvements over the study period and on the changes in rural-urban welfare differences.

In addition, we can construct cost of living indexes (*CLI*s) at given utility and make cost of living comparisons over time. The *CLI* is the relative cost of reaching a given standard of living, i.e., *u*, for two different price regimes. However, the most commonly used measure of the *CLI* is the consumer price index, which is essentially a Laspeyres price index — $L(p^1, p^0) = \sum p^1 x^0 / \sum p^0 x^0$, where p^0 and p^1 are the prices for two different price regimes and x^0 is the quantity for the base regime, which is a comparison of consumer expenditures for a given bundle of commodities. It is well known that the Laspeyres price index gives an upward-biased estimate of the cost of living because it keeps constant commodity weights as relative prices change from one regime to another and, hence, ignores substitution effects (Deaton and Muellbauer 1980b, Huffman and Johnson 2004).

A true cost of living index is consistent with consumer demand theory and represented by the ratio of the minimum expenditures, under two different price regimes, necessary to maintain a constant utility level, as opposed to a constant basket (bundle) of goods as in the Laspeyres price index. The base-weight true cost of living index is

$$(4)\quad CLI(P_r^{2002}, P_r^t, U_q^{2002}) = \frac{e(U_q^{2002}, P_r^t)}{e(U_q^{2002}, P_r^{2002})} \quad t=2002,2003,,,2011$$

where *r*, *q* = rural households, urban households; U_q^{2002} is the utility level in the beginning year, 2002, for *q*; P_r^t is the price level for *r* households in year *t*. $e(U_q^{2002}, P_r^t)$ is the expenditure function at price P_r^t with utility level U_q^{2002} in year *t*. Of particular interest is $CLI(P_r^{2002}, P_r^t, U_r^{2002})$, the cost of living index for rural households over 2002-

2011 and $CLI(P_q^{2002}, P_q^t, U_q^{2002})$, the cost of living index for urban households over 2002-2011.

3 Data

The sample observations used in this study are a panel of provincial-level aggregates for rural and urban household in thirty-one provincial-level administrative regions of China (which included 22 provinces, 5 autonomous regions, and 4 direct-controlled municipalities). The expenditure data for rural and urban households are collected from Chinese Rural Household Survey and Chinese Urban Household Survey conducted by the National Bureau of Statistics of China from 2002-2011.

Table 1 provides short definitions of variables and summary statistics. The sample mean value for the food & drinks expenditure share is 0.42 for urban households and a larger 0.47 for rural households. The expenditure share for clothing&footwear is 0.12 for urban households and 0.07 for rural China. The share for housing is 0.11 in urban China and a larger 0.18 for rural households. The expenditure share for transportation & communication is 0.13 for urban households and 0.10 for rural households. The expenditure share for healthcare is approximately the same for urban and rural households (about 0.08). The expenditure share for recreation for urban households is 0.14, which is considerably larger than for rural China (0.10).

Definite trends exist in some of the expenditure shares. For rural households, the mean share of expenditure on food & drinks declined by 6.4 percentage points from 2002 to 2011, but the share remains steady for urban households. The expenditure share for clothing&footwear for urban households increases from 11.6% in 2002 to 12.9% in 2011; while for rural households it rises by 0.7%. For urban households, the expenditure

share for housing is 11.5% in 2002 and 10.4% in 2011, but for rural households, the comparable numbers were 17.1% in 2002 and 20.1% in 2011. The expenditure share of transportation & communication rises from 11.4% in 2002 to 14.9% in 2011 for urban households and from 7.2% to 11.3% during 2002-2011 for rural households. In urban households, the expenditure share for healthcare surprisingly decreases from 16.0% in 2002 to 12.7% in 2011, and for rural households, it decreases from 12.0% to 8.0%.

The natural logarithm of the price index for each of the commodity groups is normalized to be 0 in 2001, and Figure 2 and Figure 3 display the trend to 2011 for urban and rural households. The price index of food & drinks rises by 63% in rural China and 61% in urban China over 2001-2011. The price index of clothing & footwear declines slowly over 2001-2010. The net decrease is 7% for rural households and 14% for urban households over 2001-2011. The price index for healthcare rises steadily throughout the period, but faster in rural areas. The net increase is 6% for urban households and 19% for rural households. For the transportation & communication, the price index for urban households declines steadily throughout the period. For rural households, the price index for the transportation & communication does not change much and at the end of the period it is roughly at the same level where it started. The price index for recreation decreases by 7% over time for urban households and the net increase for rural households over the study period is 9%.

The net housing price increase over the period is 27% for rural households and 37% for urban households. The price index of housing for urban households changes slowly over 2001-2003 and then starts rising rapidly after 2003. For rural households, the price

index remains unchanged to 2003 and then rises relatively rapidly throughout the remainder of the period.

Wang (2011) discussed the public ownership of housing which was established in China in 1949 –the housing units except the ones already privately owned, were entitled to the public ownership and the state-owned housing units were assigned to workers in the state-owned enterprises by their employers. Starting from 1994 the housing-privatization was launched by the State Council of China. Wang (2011) showed that the housing-privatization increased the home ownership rate from around 55% in 1993 to over 80% in 2004 and the consumptions on housing as well as the housing prices increased after 1994.

Shen and Turner (2014) found that the household residency policy reform in 2003 increased the house price in the preferred provinces where larger admission quotas for universities were imposed as the student with the residency in the preferred province had better access to universities. The housing price is cheaper in rural areas than urban areas, thus the housing in rural areas is relatively more affordable for people who would like to purchase a house and acquire the household residency in the given province, which explains why the demand for rural housing drives up the housing price in rural areas more rapidly than urban areas.

Stone's aggregate price index is computed using the expenditure share data and price index data for each of the six commodity groups and is graphed in Figure 4, 2001-2011. This figure shows that the aggregate price index for consumption is rising steadily from 2001-2011, but it is rising more rapidly for rural than urban households. The net increase in Stone's price index over the period is 30% for urban households and 46% for

rural households.

4 Empirical Results

The LA-AIDS, equation (2), with restrictions to maintain symmetry, homogeneity, and the adding-up conditions and with a single ρ value for each system of equations are fitted to the panel of provincial urban and rural household data, 2002-2011. The demand system is estimated by ITSUR in SAS, and the estimated coefficients for urban households are reported in Table 2 and for rural households are reported in Table 3.[5] The share equation for recreation is excluded in estimation, and estimates of the coefficient in this equation are recovered residually using the estimated coefficients of the other five equations and the coefficient restrictions. The R^2s of the directly estimated share equations are in excess of 0.70, except for the housing commodity, suggesting that housing might be measured less accurately.

The coefficient estimates reported in these tables confirm a well-known fact since Deaton and Muellbauer (1980b), is that we know more about income-expenditure and own-price elasticities than cross-price elasticities. This is due to the differences in the precision of estimation for coefficients needed to compute these price elasticities. For example, the estimated coefficients for the income/expenditure regressor in Table 2 (urban households) are each significantly different from zero at the 5% level, except for healthcare, and the estimated coefficients for own-price effects, which sit at the top of each column, are each significantly different from zero at the 10% level, except for housing and transportation & communication. Off-diagonal price coefficients, which are used in computing cross-price elasticities, are significantly different from zero, except in

[5] The point estimate for ρ is 0.932 for the urban household data and 0.904 for the rural household data.

four instances.

In Table 3 (rural households), the estimated income-expenditure coefficients are each significantly different from zero at the 1% significance level. The estimated coefficients needed to estimate the own-price elasticities are significantly different from zero at the 10% level or better except housing. Estimated coefficients needed to derive cross-price elasticities are also statistically weak. However, in all cases the estimated coefficients of the demand systems are consistent with demand theory.

In Table 2, the estimated coefficient of trend is also revealing. For the food & drinks expenditure-share equation, the trend is negative, -0.007 per year (significantly different from zero at the 1% level). For clothing & footwear (transportation & communication), the trend is positive, 0.008 (0.005) per year (significantly different from zero at the 1% level. The trend in the healthcare share equation is negative (-0.002).

Tables 4 and 5 report the estimates of the income and (compensated) price elasticities for urban and rural households, respectively. For urban households, income-expenditure elasticities are reported in the last column of Table 4; 0.91 for food & drinks, 0.43 for clothing & footwear, and 0.89 for housing, 1.84 for transportation & communication, 0.99 for healthcare and 1.38 for recreation. Hence, for urban Chinese households, food & drinks, clothing & footwear, housing and healthcare are necessities and transportation & communication and recreation are luxury goods. For rural households, the income/expenditure elasticities (last column of Table 5) are 0.77 for food & drinks, 0.86 for clothing & footwear, 1.32 for housing; 1.32 for transportation & communication, 1.12 for healthcare and 1.26 for recreation. Hence, for rural Chinese households, food & drinks and clothing & footwear are also necessities but housing,

transportation & communication, healthcare, and recreation are luxury goods. Moreover, the classification of commodities as a necessity vs. luxury good is the same for urban and rural households, except for housing and healthcare. Housing is a necessity good for urban households but luxury good for rural households.

For urban households (Table 4), the (compensated) own-price elasticity of demand for food and drink is -0.26, clothing & footwear is -1.14, housing is -0.79, transportation & communication is -0.63, healthcare is -0.68 and recreation is -1.20. For food & drinks all cross-price elasticities are positive, except for transportation & communication, implying that this pair is a complement; all (compensated) cross-price elasticities for clothing & footwear (recreation) are positive, implying that these commodity pairs are substitutes; for housing, all cross-price elasticities are positive, except for transportation & communication; and for healthcare are positive, except for transportation & communication.

For rural households (Table 5), the own-price elasticity of demand for food and drinks is -0.20, clothing & footwear is -1.39, housing is -1.01, transportation & communication is -1.44, healthcare is -1.27 and recreation is -0.60. More instances of negative cross-price elasticities (complements) exist for rural than urban households, e.g., for transportation & communication and recreation in the food & drinks equation; healthcare and recreation in the housing equations; housing and transportation & communication in the healthcare equations; food & drinks in the transportation & communication equation; food & drinks and housing in the recreation equation.

5 Welfare Comparisons

With the estimated coefficients from Table 2 & 3 and provincial-level average

values of the prices, income, (trend) and expenditure shares by year over the sample period, 2002-2011 and equation (3), we compute an estimate of average welfare for urban and rural households across thirty-one provincial administrative regions in China. This calculation is graphed in Figure 6, and it shows that average welfare increasing over the study period by approximately 1% per year for urban households and 1.5% per year for rural households; and in every year, the average welfare of urban households is significantly higher than for rural households. In addition, Figure 7(A) and 7(B) show that over the study period the rural-urban household welfare differentials and the welfare ratio of urban to rural households were reduced. Average urban household welfare was 14.8% higher than for rural household welfare in 2002, and this difference declined steadily to 2011 (reaching 10.4%). Figure 8 shows that the welfare of urban households grows at approximately 1% per year and for urban households and around 1.5% per year for rural households. And for each year, the growth rate of welfare is larger for rural households than urban households.

We turn next to the cost of living comparisons. First, we generate baseline comparisons. They are the minimum expenditures for rural households, 2002-2011, to maintain the 2002 rural household utility level or $e(U_r^{2002}, P_r^t)$, and the minimum expenditures for urban households, 2002-2011, to maintain the 2002 urban household utility level $e(U_q^{2002}, P_q^t)$. In Figure 9, minimum expenditures for urban households are represented by the red line and for rural households by the purple line.

A cost of living comparison for urban households can be obtained using equation (4), e.g., $CLI(P_q^{2002}, P_q^t, U_q^{2002}) = e(U_q^{2002}, P_q^t) / e(U_q^{2002}, P_q^{2002})$. A similar construct for rural households is $CLI(P_r^{2002}, P_r^t, U_r^{2002}) = e(U_r^{2002}, P_r^t) / e(U_r^{2002}, P_r^{2002})$. We can compute the

minimum expenditures needed to maintain the 2002 urban (rural) household utility level but at rural (urban) area prices, e.g., $e(U_q^{2002}, P_r^t)$ and $e(U_r^{2002}, P_q^t)$. In Figure 9, the minimum expenditure for initial urban (rural) household utility level but at rural (urban) prices over 2001-2011 is given by the blue (green) line. Hence, the minimum expenditures to attain the initial utility level for urban (rural) households would have risen more rapidly (slowly) if they faced rural (urban) household prices over the study period.

After normalizing each of the *CLI*s to 1 in 2002 and graphing them, we obtain Figure 10. The *CLI* for urban households is represented by the red line and for rural household by the blue line. Over the study period, 2002-2011, the *CLI* for urban households increases by 4% and for rural households rises by 10%. Hence, the relative *CLI* of rural household was rising compared to urban households, and the differential over the period was approximately 6%.

Per capita household consumption for urban and rural households is plotted in Figure 12. The upper blue line is for urban households and the lower red line is for rural households. However, if we treat the price index for urban households as the reference and adjust rural household expenditure, the adjusted consumption expenditures per capita for rural households is the green line or 1% lower than the unadjusted consumption per capita. Figures 6, Figure 7(A) and 7(B) show a slight convergence (4%) in rural-urban welfare over the study period. Moreover, this welfare measure builds on consumer demand theory and provides a preferred measure of rural-urban household welfare comparisons. Figure 13 suggests that the ratio of urban consumption to the adjusted rural consumption drops by 6% during 2002-2011.

6 Conclusions

This paper examines Chinese rural and urban household expenditures on goods and services—food & drinks, clothing & footwear, housing, transportation & communication, healthcare, and recreation using an AIDS fitted to provincial aggregate data over 2002-2011. We use the estimated coefficients to provide estimates of income and price elasticities of demand for six commodity groups and make welfare comparisons over time for rural and urban households. We find that the income elasticity of demand for food is surprisingly large, but less than one, and the own-price elasticity of demand for food is small but larger for urban than rural households. The average welfare grows steadily at approximately 1% per year for urban Chinese households and 1.5% for rural Chinese households; and in every year, the average welfare of urban households is significantly higher than for rural households. In addition, over the study period the rural-urban household welfare gap narrowed slightly over 2002-2011. We provide a preferred measure of rural-urban household welfare comparisons and show a slight convergence (4%) in rural-urban welfare over the study period with the measure built on consumer demand theory.

References

Aguiar M. and Bils M. (2011), Has Consumption Inequality Mirrored Income Inequality? *NBER Working Paper* No. 16807

Allison P. (1978), Measures of Inequality, *American Sociological Review*, Vol. 43, No. 6, pp. 865-880

Atkinson A. (1970), On the Measurement of Inequality, *Journal of Economic Theory* Vol. 2, 244-263

Attanasio O., Berloffa G., Blundell R. and Preston I. (2002), From Earnings Inequality to Consumption Inequality, *The Economic Journal*, Vol. 11 (March), C52-C59

Barro R. (2000), Inequality and Growth in a Panel of Countries, *Journal of Economic Growth*, 5: 5–32

Blundell and Preston (1998), Consumption Inequality and Income Uncertainty, *The Quarterly Journal of Economics* 113 (2): 603-640.

Buhmann, Lee Rainwater, Guenther Schmaus, Timothy M. Smeeding (1988), Equivalence Scales, Well-being, Inequality, and Poverty: Sensitivity Estimates across Ten Countries using the Luxembourg Income Study (LIS) Database, *Review of Income and Wealth*, Volume 34, Issue 2, pages 115–142

Dalton H. (1920), The Measurement of the Inequality of Incomes, *The Economic Journal*, Vol. 30, No. 119, pp. 348-361

Deaton and Muellbauer (1980a), An Almost Ideal Demand System, *The American Economic Review* Vol. 70, No. 3., pp. 312-326.

Deaton, A. and J. Muellbauer. Economics and Consumer Behavior. New York, NY: *Cambridge University Press* 1980b.

Fan S., Wailes E., Cramer G. (1995), Household demand in rural China: a two-stage LES-AIDS model, *American Journal of Agriculture Economics* 77 (1): 54-62.

Fleisher B., Li H., and Zhao M. (2010), Human capital, economic growth, and regional inequality in China, *Journal of Development Economics* Vol. 92, 215–231

He D. and Chidmi B. (2011), Analyzing the Impact of Food Safety Information on Food Demand in China, *Agricultural & Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meetings*.

He J. and Li S. (2010), Predicting Expenditure Patterns across provinces in China

based on AIDADS demand system, *Prepared for Thirteenth Annual Conference on Global Economic Analysis*

Hovhannisya, V. and B.E. Gould. (2013). Structural change in urban Chinese food preferences. *Agricultural Economics*.

Huffman S., Johnson S. (2004), Impacts of economic reform in Poland: incidence and welfare changes within a consistent framework, *Review of Economics and Statistics* Vol. 86, No. 2, 626-636.

Huffman W. (2011), Household production and the demand for food and other inputs: US evidence., *Journal of Agricultural and Resource Economics*, Vol. 36, No. 3, 465-487.

Jones Derek , Li Cheng , Owen Ann (2003), Growth and regional inequality in China during the reform era, *China Economic Review* 14, 186 – 200

Kanbur R and Zhang X.(1999), Which Regional Inequality? The Evolution of Rural–Urban and Inland–Coastal Inequality in China from 1983 to 1995, *Journal of Comparative Economics* 27, 686 –701

Li S. and Xu Z. (2008), The Trend of Regional Income Disparity in the People's Republic of China, *ADB Institute Discussion Paper* No. 85

Lu Ding (2002), Rural – urban income disparity: impact of growth, allocative efficiency, and local growth welfare, *China Economic Review* 13,419 – 429

Lu M. and Chen Z. (2006), Urbanization, Urban-Biased Policies and Urban-Rural Inequality in China,1987–2001, *The Chinese Economy* , vol. 39, no. , May–June 2006, pp. 42–63.

Nguyen B., Albrecht J., Vroman S., Westbrook M. (2007), A quantile regression decomposition of urban–rural inequality in Vietnam, *Journal of Development Economics* 83, 466 – 490

Schultz R. (1951), On the Measurement of Income Inequality, *The American Economic Review*, Vol. 41, No. 1, pp. 107-122

Shen L. and Turner T.M., 2014. Are Rising College Premiums Capitalized into House Prices? Evidence from China. *Working paper*

Terry S.,Yue X., Bjorn G., and Li S. (2007), The Urban-Rural Income Gap and Inequality in China, *Review of Income and Wealth Series* 53, Number 1

Wang, S., 2011. State Misallocation and House Prices: Theory and Evidence from China. *American Economic Review*, 101, 2081-2107

Yang D. (1999), Urban-Biased Policies and Rising Income Inequality in China, *The American Economic Review*, Vol. 89, No. 2, pp.306-310

Yao S. and Zhang Z. (2001), On Regional Inequality and Diverging Clubs: A Case Study of Contemporary China, *Journal of Comparative Economics* 29, 466–484

Table 1. Variable Definitions

Variables	Summary Definitions	Urban	Rural
		Mean (SD)	Mean (SD)
$s_{Food\&drinks}$	Expenditure share for food and drinks	0.415(0.042)	0.473(0.072)
$s_{Clothing\& footwear}$	Expenditure share for clothing and footwear	0.120(0.027)	0.067(0.019)
$s_{Housing}$	Expenditure share for housing including utility	0.112(0.016)	0.181(0.040)
$s_{transportation\&communication}$	Expenditure share for transportation&communication	0.134(0.027)	0.100(0.022)
$s_{Healthcare}$	Expenditure share for healthcare	0.079(0.017)	0.074(0.021)
$s_{Recreation}$	Expenditure share for recreation	0.140(0.026)	0.104(0.032)
$\ln P_{Food\&drinks}$	The price index for food and drinks	0.121(0.115)	0.157(0.135)
$\ln P_{Clothing\& footwear}$	The price index for clothing clothing and footwear	0.227(0.161)	0.263(0.179)
$\ln P_{Housing}$	The price index for housing including utility	-0.088(0.102)	-0.052 (0.114)
$\ln P_{Transportation\&communication}$	The price index for transportation&communication	0.008(0.063)	0.045(0.080)
$\ln P_{Healthcare}$	The price index for healthcare	0.173(0.123)	0.209(0.145)
$\ln P_{Recreation}$	The price index for recreation	-0.075(0.062)	-0.038(0.063)
Y	Average income-expenditure per person	8,524.365(3,279.209)	3,104.585(1,679.855)
T	Trend		

Table 2. ISUR estimate of coefficients of LA-AIDS for urban China, 2002-2011(t-value in parentheses)[1]

Expenditure share	Food&drinks	Clothing&footwear	Housing	Healthcare	Transportation&Communication
$\ln P_{Food\&drinkds}$	0.136***				
	(5.36)				
$\ln P_{Clothing\& footwear}$	-0.026**	-0.032**			
	(-2.03)	(-2.53)			
$\ln P_{Housing}$	-0.009	-0.004	0.010		
	(-0.71)	(-0.39)	(0.55)		
$\ln P_{Healthcare}$	-0.009	-0.015*	0.037***	0.024*	
	(-0.81)	(-1.66)	(3.12)	(1.67)	
$\ln P_{Transportation\&communcation}$	-0.056***	0.049***	-0.023	-0.049***	0.023
	(-3.77)	(3.92)	(-1.42)	(-3.40)	(0.90)
$\ln Y / P^*$	-0.038***	-0.068***	-0.013**	-0.001	0.067***
	(-3.27)	(-10.08)	(-2.18)	(-0.23)	(9.34)
t	-0.007***	0.008***	-0.001	-0.002***	0.005***
	(-3.77)	(8.18)	(-0.77)	(-2.76)	(4.19)
Constant	14.732***	-15.969***	1.755	4.594***	-11.081***
	(4.01)	(-7.90)	(0.89)	(2.84)	(-4.41)
R-sq.	0.742	0.803	0.558	0.748	0.780

[1]The recreation expenditure share equation is the excluded equation.

Note:*** p<0.01, ** p<0.05, * p<0.1

Table 3. ISUR estimates of coefficients of LA-AIDS for rural China, 2002-2011 (t-value in parentheses)[1]

Expenditure Share	Food&drinks	Clothing&footwear	Housing	Healthcare	Transportation&Communication
$\ln P_{Food\&drinkds}$	0.155***				
	(3.47)				
$\ln P_{Clothing\& footwear}$	-0.020*	-0.031***			
	(-1.90)	(-3.65)			
$\ln P_{Housing}$	-0.004	0.035***	-0.035		
	(-0.12)	(2.60)	(-0.73)		
$\ln P_{Healthcare}$	-0.010	0.013	-0.041**	-0.037**	
	(-0.69)	(1.43)	(-2.24)	(-2.03)	
$\ln P_{Transportation\&communcation}$	-0.063***	0.004	0.077***	0.018	-0.038*
	(-4.58)	(0.43)	(3.98)	(1.27)	(-1.88)
$\ln Y / P^*$	-0.111***	-0.010***	0.058***	0.012***	0.024***
	(-9.12)	(-3.26)	(5.75)	(3.06)	(6.12)
t	-0.010***	0.001	0.003	0.005***	0.004***
	(-3.86)	(1.44)	(1.20)	(4.82)	(3.21)
Constant	21.082***	-2.077	-5.421	-9.903***	-7.243***
	(4.15)	(-1.36)	(-1.26)	(-4.85)	(-3.26)
R-sq.	0.771	0.816	0.486	0.710	0.745

[1]The recreation expenditure share equation is the excluded equation.

Note:*** p<0.01, ** p<0.05, * p<0.1

Table 4. Estimates of compensated price and income elasticities for urban Chinese households, 2002-2011[1]

Elasticity	Food & drinks	Clothing & footwear	Housing	Healthcare	Transportation & Communication	Recreation	Income
Food & drinks	-0.256	0.058	0.090	0.113	-0.055	0.051	0.908
Clothing & footwear	0.199	-1.143	0.077	0.009	0.484	0.374	0.431
Housing	0.333	0.083	-0.794	0.463	-0.122	0.038	0.886
Healthcare	0.350	0.008	0.388	-0.683	-0.289	0.236	0.991
Transportation& Communication	-0.287	0.732	-0.173	-0.486	-0.632	0.845	1.837
Recreation	0.152	0.320	0.030	0.215	0.479	-1.195	1.384

[1]Coefficient estimates are from Table 2 and elasticities are evaluated at the sample mean of the data.

Table 5. Estimates of compensated price and income elasticities for rural Chinese households, 2002-2011[1]

Elasticity	Food & drinks	Clothing & footwear	Housing	Healthcare	Transportation & Communication	Recreation	Income
Food & drinks	-0.199	0.026	0.172	0.080	-0.060	-0.019	0.765
Clothing & footwear	0.182	-1.390	0.701	0.293	0.134	0.080	0.857
Housing	0.449	0.260	-1.013	-0.128	0.467	-0.064	1.320
Healthcare	0.375	0.196	-0.232	-1.272	-0.254	0.679	1.121
Transportation& Communication	-0.381	0.122	1.217	0.345	-1.438	0.135	1.322
Recreation	-0.088	0.051	-0.112	0.656	0.096	-0.604	1.256

[1]Coefficient estimates are from Table 2 and elasticities are evaluated at the sample mean of the data.

Figure 1. Consumption for urban and rural households in China, 2002-2011(Yuan)

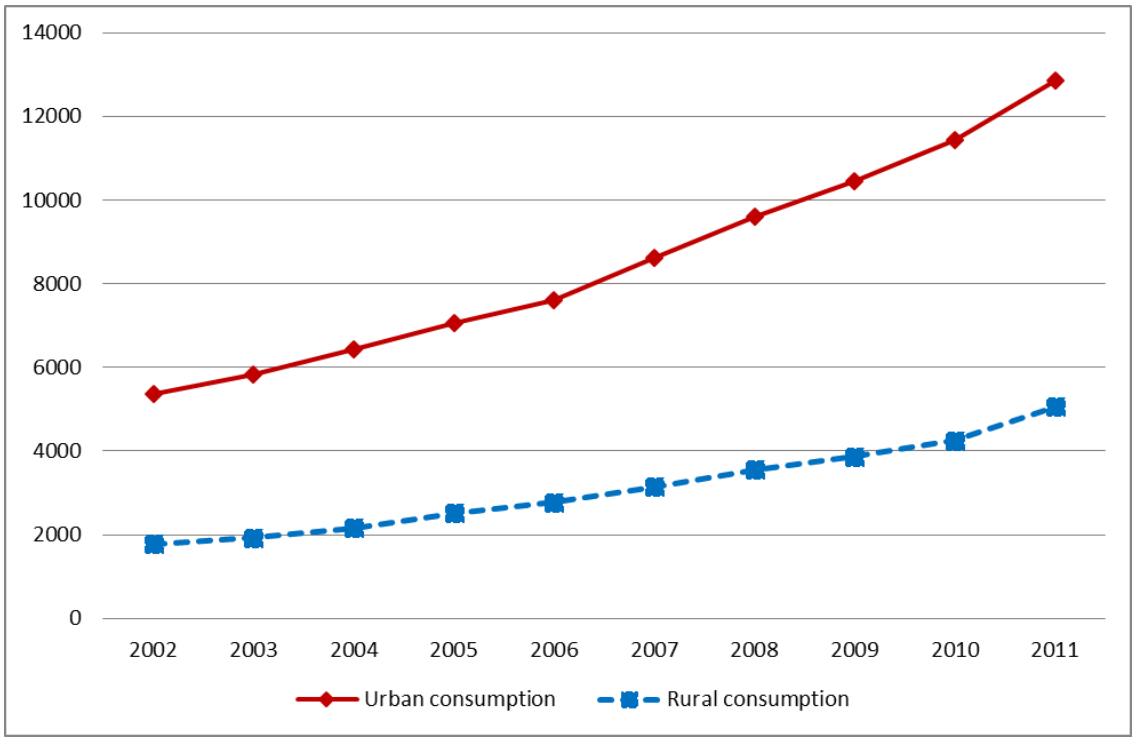
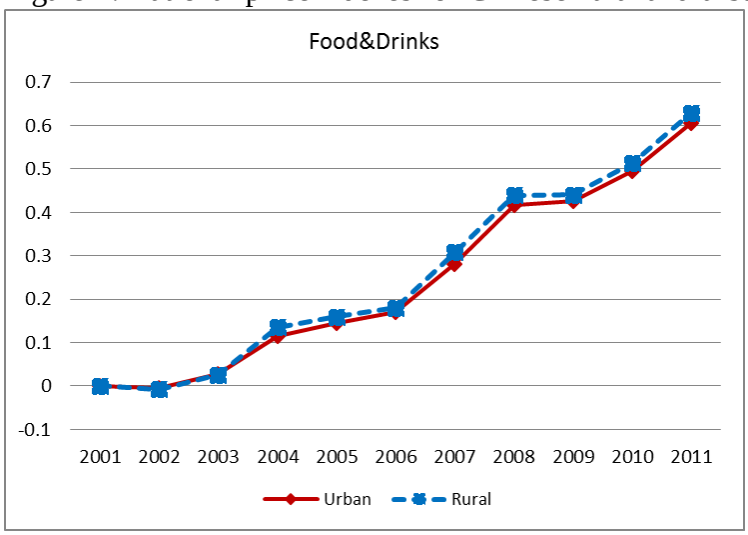
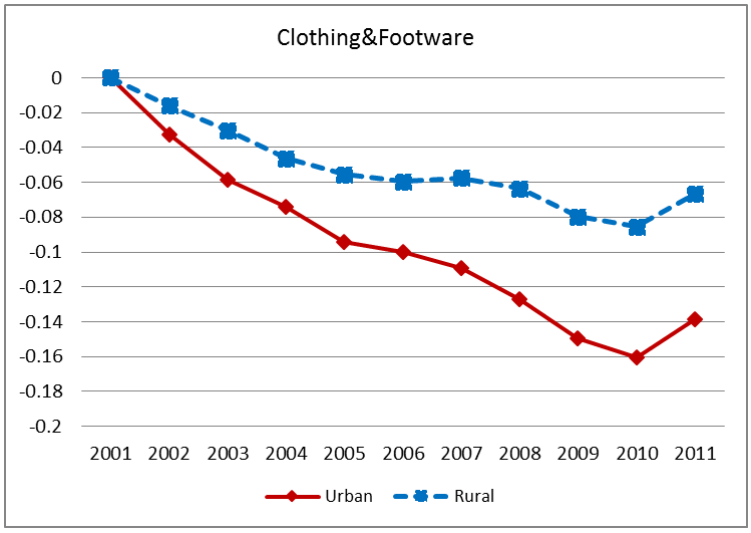


Figure 2. National price indexes for Chinese rural and urban households, 2002-2011





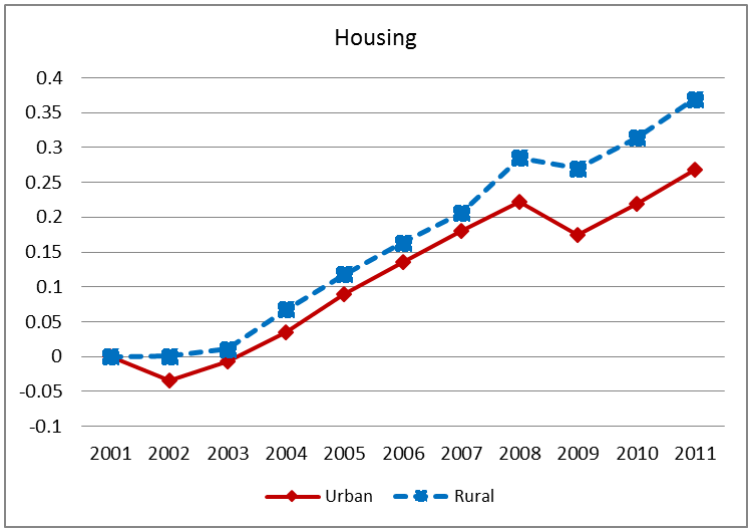
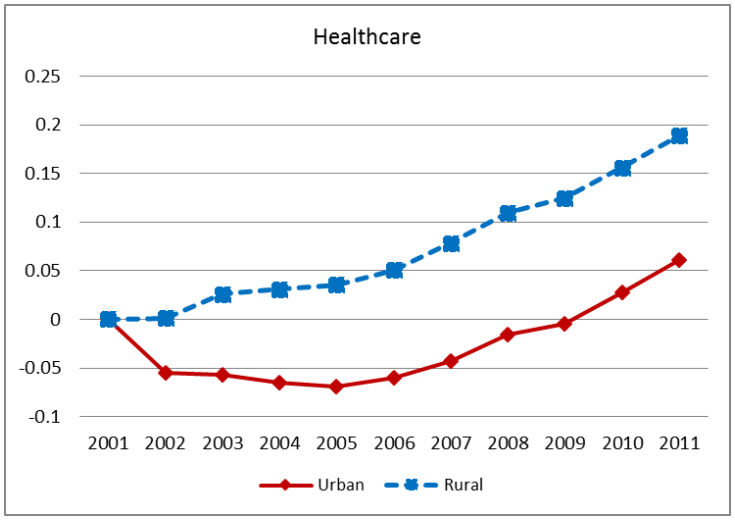
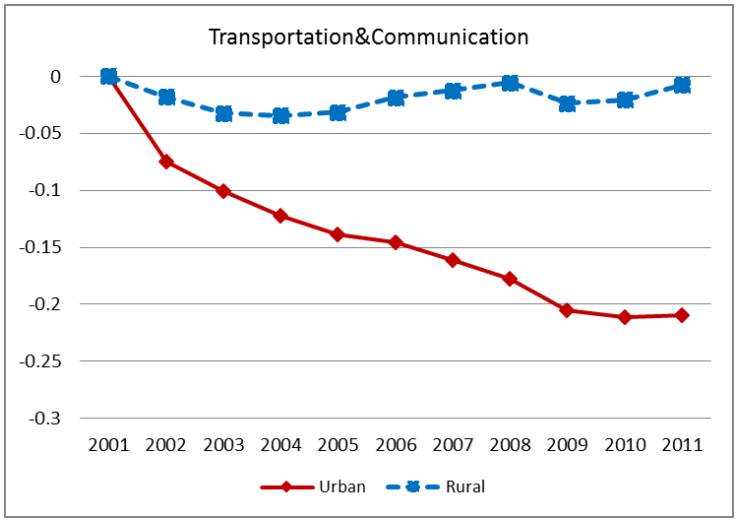


Figure 3. National price indexes for Chinese rural and urban households, 2002-2011, continued





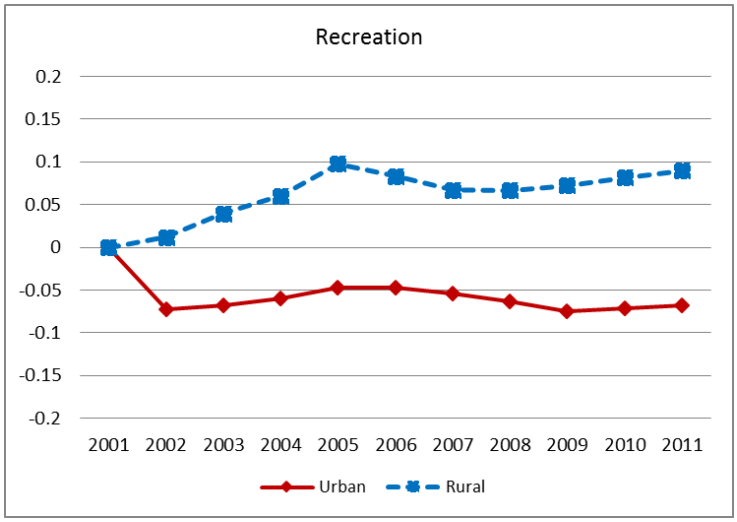


Figure 4. The Stone price index in urban and rural China, 2002-2011

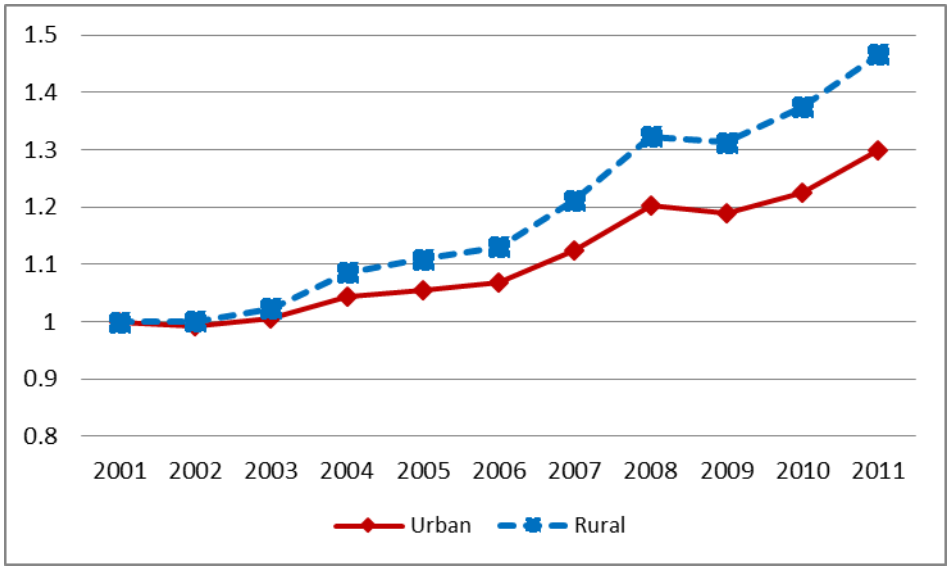


Figure 5. The ratio of the Stone price index for urban and rural China, 2002-2011

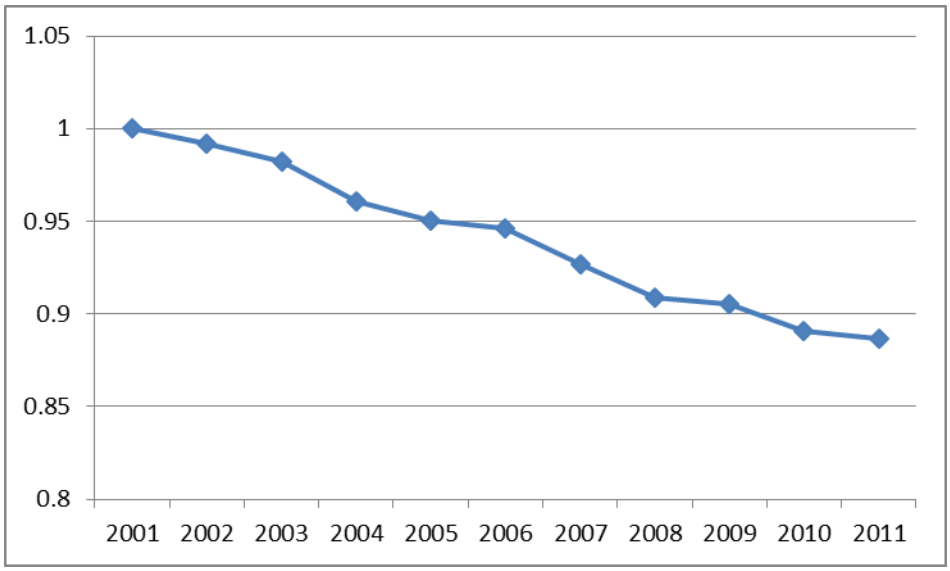


Figure 6. Estimate of average welfare for urban and rural households, 2002-2011

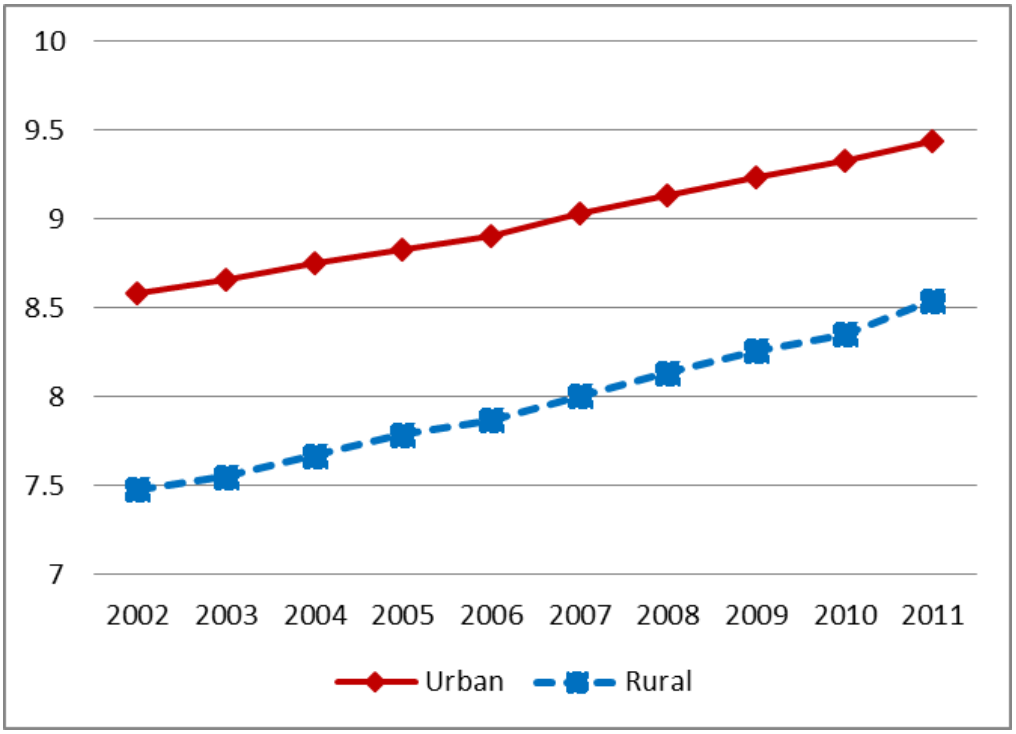


Figure 7(A). Relative welfare of urban-to-rural households, 2002-2011

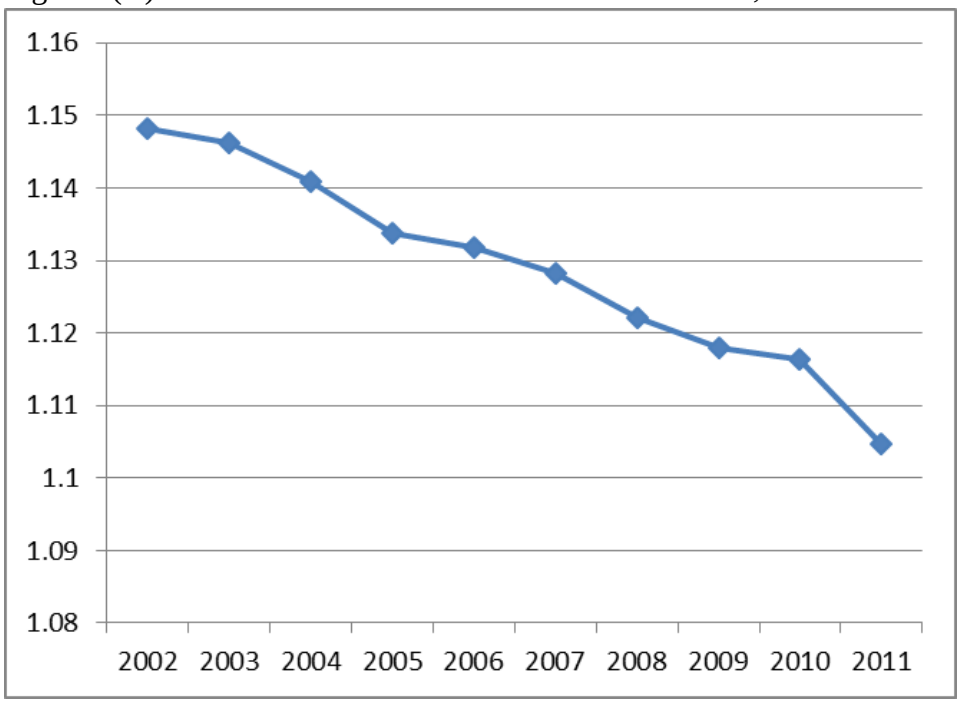


Figure 7(B). Welfare differential between urban and rural households, 2002-2011

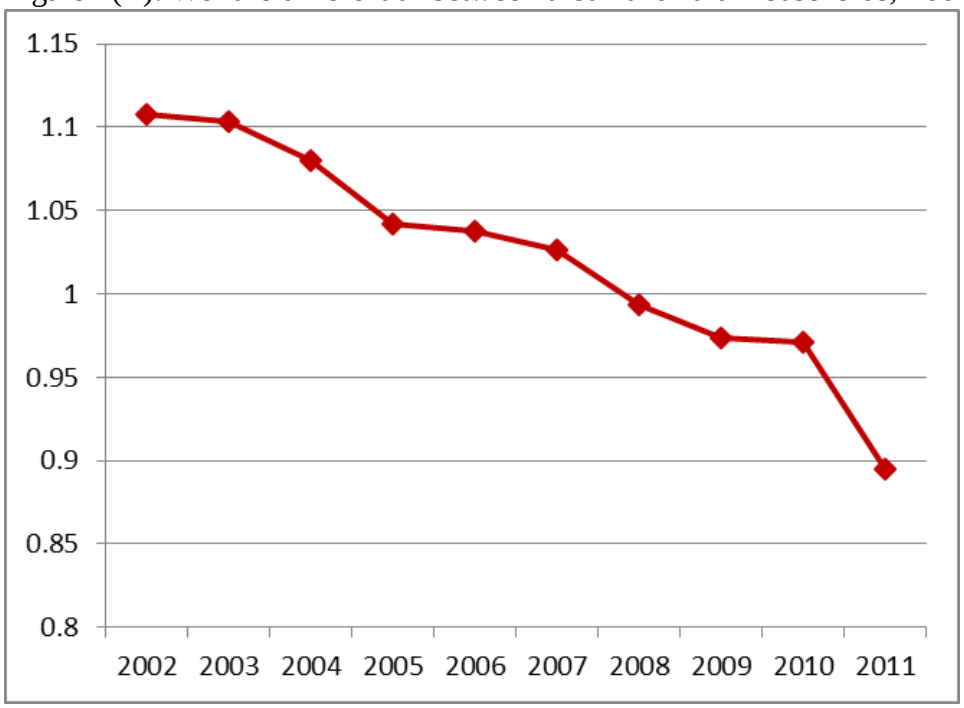


Figure 8. Annual welfare growth rate for urban and rural households, 2002-2011

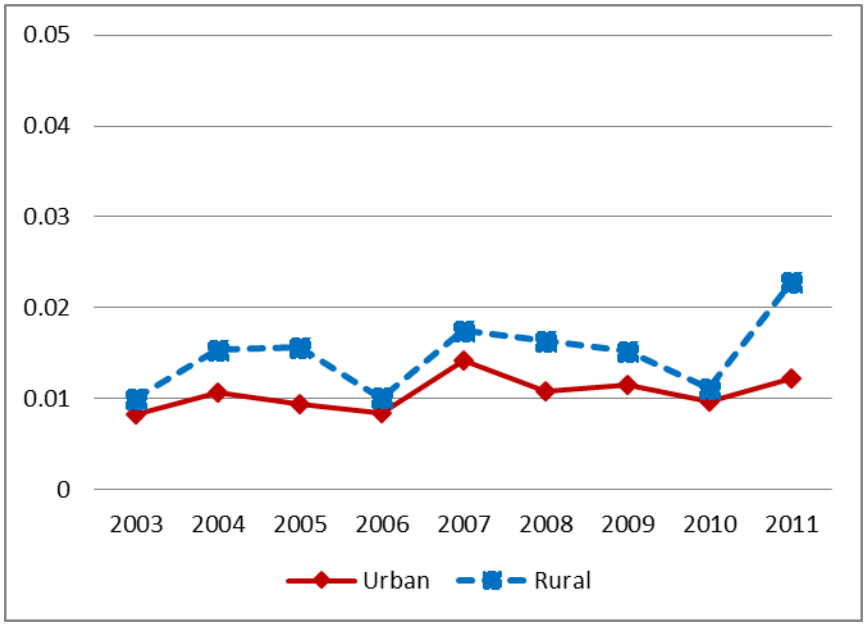


Figure 9. The minimum expenditures in Yuan by urban/rural households, 2002-2011, to maintain the 2002 utility (welfare) level of rural/urban households

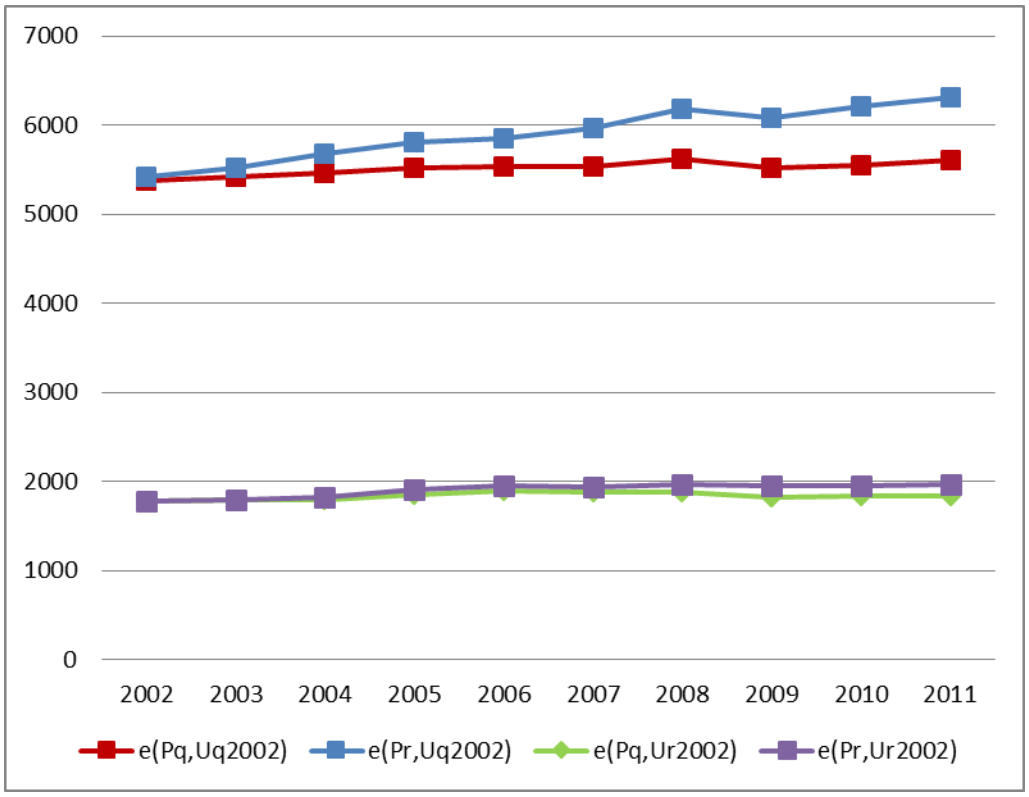


Figure 10. The cost of living index (*CLI*) for urban and rural households, 2002-2011

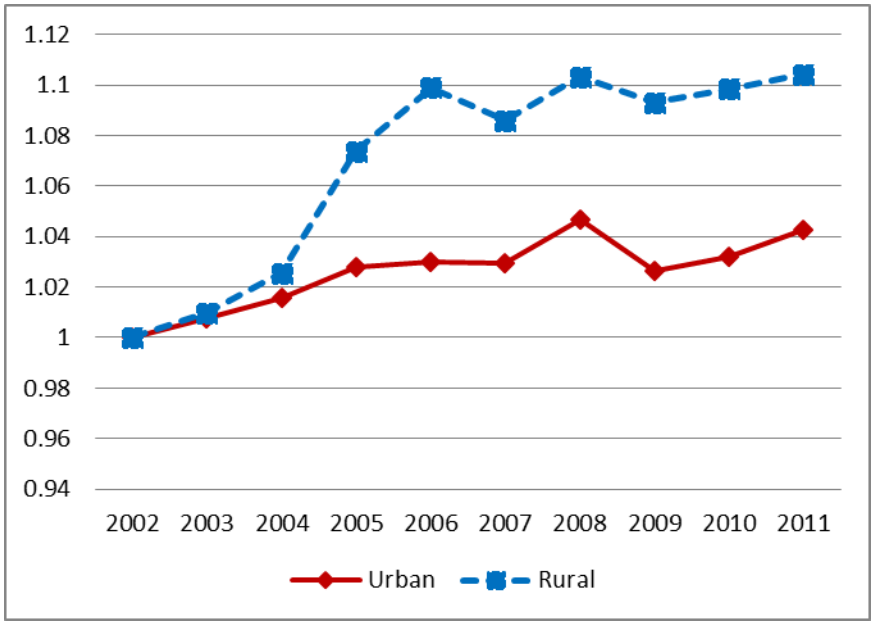


Figure 11. The ratio of cost of living index (CLI) for urban households to rural households, 2002-2011

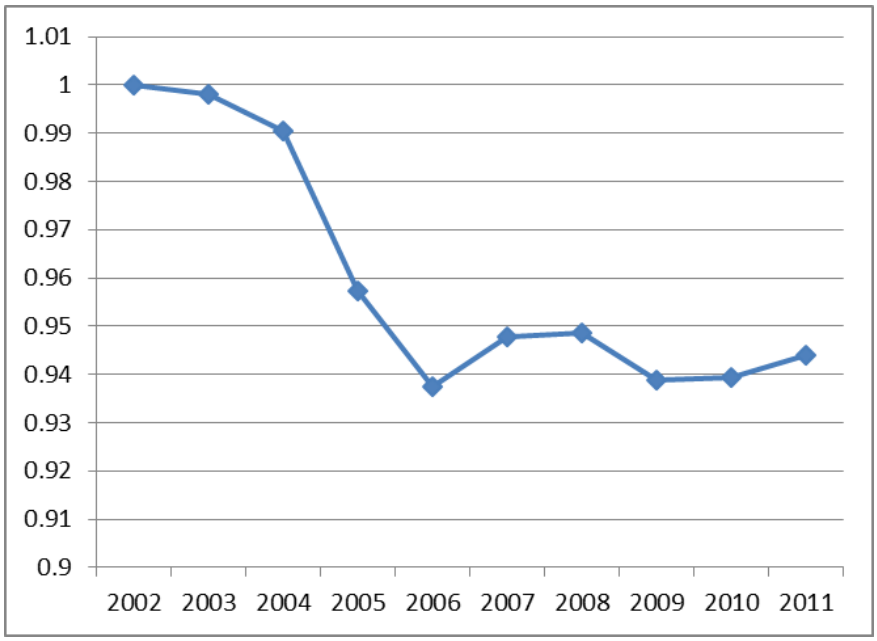


Figure 12. Consumption per capita of urban and rural households and rural household consumption adjusted for cost of living differences, 2002-2011(Yuan)

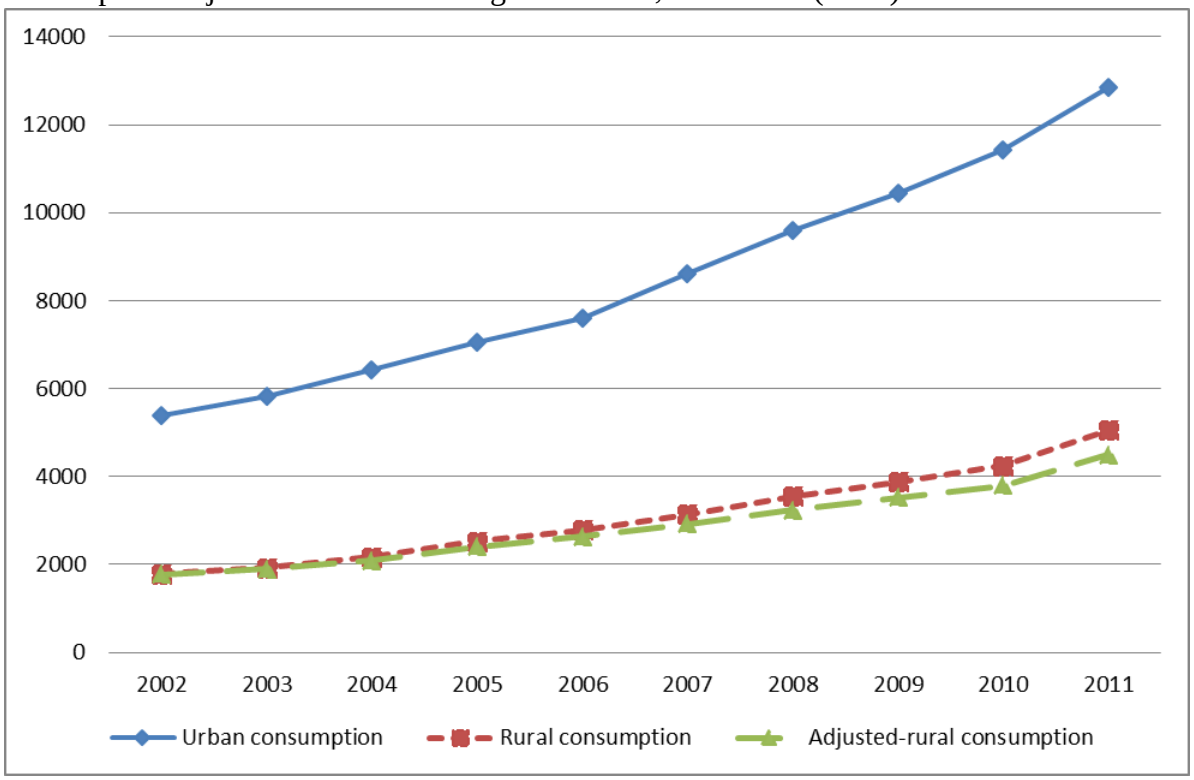


Figure 13: The ratio of the urban consumption to the adjusted and unadjusted rural consumption